Appendix R: RMP Public Document

PG&E National
Energy Group

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January 22, 2001

Mr. John Kolb, REHS
Environmental Health Specialist II
Hazardous Materials Division
San Diego County Department of Environmental Health
P.O. Box 129261
San Diego, CA 92112-9261

Subject: RMP Public Document (County Reference #H39211)

Dear Mr. Kolb:

This letter is in response to your initial review of the RMP Public Document for our peak power pl nt facility, which will be located at 3497 Main Street, Chula Vista, CA 91911. In the following sec ion , I explain how we have corrected, revised, or clarified issues that you brought out in your initial rev ew letter dated 11/27/00.

2745.3 RMP Executive Summary Component

- Distance to endpoint information will not be included in the Executive Summary pages.

2745.4 RMP Offsite Consequence Analysis Component

- Polyball storage, maintenance, and inspections are detailed in Section 3.2 of the revised RMP Pul lic Document. Polyballs will be stored lying on the surface of the secondary containment area. Wl en maintenance is performed in the secondary containment area, workers will clear a walkway and w rk area free of polyballs. Polyballs will not be removed from the containment area, they will sinply be pushed back and "dammed" with 2"X6" boards. This will ensure that the balls are not dama ed during maintenance.
- Polyballs will be inspected regularly. If polyballs are deteriorating or damaged for any reason, tl ey will be replaced. The polyballs will be put on a replacement program as recommended by he manufacturer.
- Rainwater will fall in the area where polyballs are stored. The rainwater will drain to a valve that ill remain closed during normal operation. This valve will be opened by the PG&E DG Area Mana er after rain has occurred. It is estimated that there will be no more than one-half inch (½") of rai wa er in the area prior to the valve being opened. The capacity of the secondary containment will exc ed 110% of the tank volume plus rainfall from a 100 year, 24-hour storm.
- Secondary containment areas will be designed and constructed adequately and sealed to prev nt leaks.
- Wording in the footnote below Table 4-1 and the first paragraph on page 4-4 have been changed to reflect your recommendation.
- Worst case and alternate scenario modeling was performed as agreed upon at our November 17, 2( )0 meeting. Section 4.0 was faxed to you by James Westbrooke. This section of the report was deen ed to be acceptable.

2745.5 Five Year Accident History Component

- We have corrected typographical errors and updated the correct HMD phone number.

2745.6 RMP Program 2 Prevention Program Component

- We have made the correction on page 6-1 to "regulated substance."
- All ammonia alarms will have visual recognition as opposed to audio alarms.
- PG&E DG personnel will respond to all alarms (false or otherwise). The San Diego PG&E DG Area Manager will respond as follows:

  One Alarm - After the system parameters are checked out by the Remote Operator and it is determined to be a false alarm, it is estimated that a PG&E DG Area Manager representative will respond to the false alarm within 4 hours. The Area Manager will take maintenance measures to determine how the alarm was triggered and how to get the sensor back on-line.

  Two Alarms - The ammonia system will be shut down immediately by the Remote Operator. This will minimize or eliminate further discharge of ammonia (assuming it is not a double false alarm). System parameters (tank level, pressure release, etc.) will be monitored remotely and a PG&E DG representative will be dispatched to the site immediately.

  If alarms persist after system is shut down, local emergency clean-up contractors will be dispatched immediately. Also, local Fire Department and the County HAZMAT Team will be notified of the spill. Local responders will serve to protect the public and the clean-up contractor will be primarily responsible for release mitigation and spill clean up.

2745.8 RMP Emergency Response Program Component

- PG&E DG realizes that they have primary responsibility for spill response and mitigation. PG&E DG will contract with a local company to be on call for spill response 24 hours, 7 days a week. This contractor will be trained in spill response practices for aqueous ammonia and will be familiar with the facility. If special spill clean-up and mitigation equipment is required, it will be located on site or contained in the contracted emergency response vehicle.
- Due to the unmanned nature of this facility, PG&E DG also realizes that facility emergency response planning and training with the local first responders is appropriate. PG&E DG will perform table top exercises with the local emergency responders and their contracted emergency responder. The facility emergency response plan will be amended and improved as a result of tabletop exercises. PG&E DG will meet with Mr. Mike Handman to initiate training with the local emergency responders.
- Section 9.0 of the Public RMP will serve as the foundation for emergency response at this facility. However, specific detailed emergency response procedures will be developed and contained in the RMP Technical Document. The "Hazardous Materials Business Plan" will be one of the plans in the RMP Technical Document that will identify names and phone number of all responsible PG&E-DG responders and alternates.

Other Issues:

- Two copies of the RMP Public Document will be submitted to the HMD after the revisions have been made.
- PG&E also realizes the following:

  A physical site walk down and inspection of the facility must be conducted after completion of construction and prior to aqueous ammonia being brought on site above threshold planning quantities. Based on this site inspection and a final construction, revisions to the RMP may be required. At a minimum, the following items will be addressed and contained in the RMP Technical Document:

- Exact number and location of ammonia sensors.
- Initial training of topics indicated in section 6-4 Employee and Contractor Training Requirements.
- Administrative SOP's listed on pages 3-2, 3-3, 6-5, 6-6.
- Recommendations listed on pages 6-4 and 6-5.
- Forms to be used for incident follow-up.

Please review the revised Public RMP and contact me with any remaining questions. I can be reached at 415-288-5678.

Sincerely,

PG&E Dispersed Generating Company, LLC

Gary Veerkamp

Gary Veerkamp
Manager
Design and Installation

cc: Zachary Jacobs, Jacobs Consulting
Dale Mesplé

California Accident Release Prevention (CalARP) Program

Risk Management Plan (RMP) Public Document

For:

PG&E Dispersed Generating (PG&E-DG), LLC
Chula Vista Peak Power Generating Plant
3497 Main Street, Chula Vista, CA

Submitted to:
County of San Diego
Department of Environmental Health
Hazardous Materials Division

Public RMP Prepared by:
Jacobs Consulting

Modeling Prepared by:
Westbrook Environmental

January, 2000

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SECTION 1.0
RMP EXECUTIVE SUMMARY

1.1 Introduction and Background

The County of San Diego Department of Environmental Health (DEH), Hazardous Materials Division (HMD) has requested that a California Accidental Release Prevention (CalARP) Program be prepared for the PG&E Dispersed Generating Company, LLC (PG&E-DG) generating station to be constructed in Chula Vista. Compliance CalARP has lead to the development of this public Risk Management Plan (RMP) for the storage and use of 12,000 gallons of 19% aqueous ammonia. This RMP Public Document presents PG&E-DG's efforts to manage and minimize risks associated with the storage and use of aqueous ammonia at this natural gas power generation facility, to be located at 3497 Main Street in the City of Chula Vista, CA in the County of San Diego, California.

This public RMP summarizes the technical and administrative procedures that comprise the CalARP Program as specified in the California Code of Regulations (CCR) Title 19, Division 2, Chapter 4.5. This plan summarizes the system processes involving ammonia use and the potential hazards associated with the subject aqueous ammonia. The specific approach and technical evaluation methods used to review the system processes and mitigate potential hazards will be provided in more detail in the facility RMP Technical Document, which will be made available to the County DEH upon request.

1.2 Accidental Release Prevention and Emergency Policy

PG&E-DG endeavors to protect the health and safety of its employees, officers, the environment and the general public. PG&E-DG seeks to comply with all requirements, both substantive and reporting, of all environmental, health, and safety statues, regulations, ordinances, and permits affecting the operations and maintenance of all PG&E-DG generating facilities. PG&E DG management believes it necessary to demonstrate that regional managers, and the maintenance employees are properly trained in order to assure their safety as well as the safety of others in the vicinity. Since this facility will be unmanned, active control systems and area ammonia sensors are an integral part of PG&E-DG's detection and response mechanism. Emergency response policies and plans will be in place to allow for quick, effective emergency response when necessary. PG&E-DG will maintain compliance with Local, State and Federal safety regulations, environmental regulations, building codes, as well as industry-specific design codes to ensure that risks are minimized.

1.3 Description of Regulated Process and Substance

PG&E-DG will use aqueous ammonia to control emissions of oxides of nitrogen (NOx) from the natural gas turbine exhaust at the Chula Vista power generation facility. The aqueous ammonia will be stored in a single 12,000-gallon tank. The aqueous ammonia will be piped to a Selective Catalytic Reduction (SCR) process where it is released into the exhaust stream to reduce NOx emissions. Thus, aqueous ammonia usage is essential to complying with applicable air quality standards and regulations to provide adequate public health protection from NOx emissions. Aqueous ammonia will only be in-transfer to the SCR unit when the turbine operates, which is estimated to be less than 5,000 hours per year.

The ammonia concentration in solution will be 19% by weight. The ammonia evaporation rate from a spill would be slow, allowing ample time to mitigate a potential release, contain the spill extent, and minimize potential off-site impacts below levels that would cause adverse health impacts and/or a public nuisance. The resulting RMP analysis and associated design features substantiate that aqueous ammonia will pose minimal potential public health hazard outside the facility boundaries.

Ammonia at normal temperatures and pressures is a colorless gas made up of one part nitrogen and three parts hydrogen (NH_3). It is lighter than air and has a sharp pungent odor that serves as a warning of its presence. Although ammonia is a relatively toxic substance, it is not a cumulative poison. It is highly soluble in water and forms a solution known as ammonium hydroxide, which is commonly used as a household cleaner. The Department of Transportation (DOT) classifies aqueous ammonia as a nonflammable liquid.

It is important to note that RMP applicability for the Chula Vista power generation facility is a California "state-only" requirement. The U.S. Environmental Protection Agency (USEPA) has exempted the use of less than 20% aqueous ammonia solution from consideration for the federal Risk Management Program (CFR Title 40, Part 68 – Chemical Accident Prevention Provisions). In doing so, USEPA has acknowledged the relatively low public health hazard that low-concentration aqueous ammonia presents. To be consistent with the federal program, the California Office of Emergency Services is currently undertaking Phase II rulemaking to exempt the use of less than 20% aqueous ammonia solution. However, exemption for the use of ammonia (<20%) has not occurred as of the date of this submittal.

1.4 Release Scenarios and Mitigation Measures

Aqueous ammonia is the only regulated substance at this PG&E-DG facility subject to CalARP Program requirements. Under the provisions of the CalARP, this facility is required to analyze a "worst-case" release scenario and "alternate scenario" modeling.

The worst-case release scenario at this facility involves the complete release of the contents of the full aqueous ammonia storage tank of 12,000 gallons or approximately 16,500 lbs. of ammonia. The CalARP Program requires that a complete discharge from the tank during a period of just 10 minutes be analyzed in combination with worst-case meteorological data for the region. The tank will be located outdoors with a containment berm and polyballs inside the containment area. Allowances in the modeling were made for the passive mitigation (berms and polyballs). The polyballs inside the containment berm reduce the surface area of the ammonia liquid by about 80%, which reduced the estimated releases. The aqueous ammonia would be released from the tank as a liquid and then flashed to a vapor as it evaporates naturally. For the worst-case scenario, passive mitigation features can be taken into account, but no active features (such as safety procedures and emergency shutdown systems) could be considered.

The alternate scenario is established during ammonia truck unloading operations. This scenario assumes that the transfer hose between the loading truck and ammonia tank decouples. The maximum spill includes all contents of the transfer hose (15 feet long with 2 inch diameter) and a 30 second release of ammonia at the maximum truck transfer pump rate of 100 gallons/minute before the valve is shut. PG&E DG will use a system of containment dikes, berms, and/or sumps in the truck unloading area as assurance that the spill surface area will not exceed this maximum surface area value.

1.5 Accidental Release Prevention Program

This public RMP document addresses safety procedures, accident prevention, analysis of external events, and emergency response. The RMP will illustrate the potential effects of accidental releases and implementation of design features to minimize risk. PG&E-DG will implement a variety of facility improvements and Standard Operating Procedures (SOP's) that provide for the identification, prevention and minimization of ammonia releases. For example, design features will include containment berms, unloading controls, emergency shutdown procedures, ammonia sensors, alarms, training, emergency response, and appropriate safety procedures.

Procedures in combination with enhanced facility features significantly reduce the risk of a release and minimize the extent of a release if an accident were to occur. The major safety systems in place at the facility will include process safety equipment, and administrative safety procedures. Since this facility is to be newly constructed, it will be designed and built according to the latest safety codes, building codes, and other standards for electrical, mechanical, and structural integrity. Specific process safety equipment includes a number of redundant systems, made up of local and remote indicators, sensors, and alarms that monitor operating levels, pressures and temperatures, and relay information to the facility control room through an automated plant control system. The system design is set up so that when problems occur, the system shuts itself down in a manner designed to reduce the opportunity for releases to occur. In addition, sensors connected to alarms will be in place to detect releases of ammonia. These sensors can also trigger the ammonia system to be shut down and/or initiate emergency shut down procedures.

A number of administrative safety procedures complement the process safety equipment at the PG&E-DG facility. These include written SOP's for all ammonia-related processes, which will include, but not be limited to, site safety inspections, system maintenance procedures, ammonia delivery tank loading procedures and emergency response procedures. An regional manager training program encompassing operating procedures, safety and health, and emergency response with a biennial re-qualification requirement, will provide assurance that employees are able to think, act, and work safely while in the presence of ammonia. The facility will operate in compliance with all Federal and State emergency response and safety planning requirements, including the Spill Prevention, Control and Countermeasures Plan (SPCC), Storm Water Pollution Prevention (SWPP) Plan, Hazardous Materials Business Plan (HMBP), and this CalARP RMP.

1.6 Five-Year Accident History

This public RMP is for a new facility that is to be constructed. Therefore, no accidental releases of ammonia at this PG&E-DG facility have occurred within the last five years.

1.7 Planned Changes to Improve Safety

Since this is a new facility, implementing ammonia process safety hinges on the following three major categories:

1) Demonstrating that the system is designed to current codes and standards, (i.e., building codes, seismic codes, industry standards, etc.)
2) Documenting effective management practices (i.e., SOP's, Emergency Plans, etc.) are in-place and employees are properly trained prior to ammonia delivery.
3) Demonstrating that the facility is constructed as per the designs and that the system operates properly once it is installed.

The evidence that safety systems and procedures are in place will be presented in the RMP Technical Document. The RMP Technical Document must be completed before ammonia is delivered to the site.

SECTION 2.0
FEDERAL EPA RISK MANAGEMENT DATA ELEMENTS

(Not Applicable)

This facility is only subject to California Accident Release Prevention (CalARP) Program

SECTION 3.0
SAFETY FEATURES AND PRACTICES

3.1 Background

This facility is a new installation and has no operating history. Since it is a new facility, it will be designed to assure safety and minimize the potential for ammonia releases. The system will have several features (control system, ammonia sensors, pressure gauges, etc.) which assure the system will operate safely and automatically perform emergency shut down. TECHNIP has been selected to provide the design of the Selective Catalytic Reduction (SCR) system. Both TECHNIP and PG&E-DG have extensive experience with operating ammonia systems in a safe and effective manner.

Along with the proper system safety equipment, PG&E-DG will implement standard operating procedures (SOP's) and practices to assure proper operation and minimize the potential for accidental ammonia releases. SOPs to be implemented at this facility will be based on experience, manufacturers input, industry standards, and government regulations, which provide guidance for the safe startup, operation, and shutdown of the system. SOPs will also be developed for loading the system with ammonia, maintenance, emergency shutdowns, and trouble-shooting. This section of the RMP Public Document provides an overview of safety features and procedures that PG&E-DG will have in place to assure safe ammonia process operation. The RMP Technical Document will contain specific company SOP's, process equipment, and facility diagrams.

3.2 System Safety Features

To assure public safety and proper operation, PG&E-DG will install and implement several passive and active controls for the ammonia process. Passive controls will be in place and function to reduce potential releases without the assistance of motor valves, automatic shutdown, sensors, and/or manual intervention. Passive controls that will be implemented at this site include complete berming of the ammonia tank to in excess of 110% capacity plus rainfall.

The tank containment area will house polyballs, which will float if a spill occurs. The polyballs will reduce the effective surface area of the ammonia and reduce the amount of ammonia that would be released. Polyballs will be stored in the secondary containment area lying on the surface to ensure that they serve as passive control at all times. Polyball condition will be included in facility environmental and safety inspections. If defects or deterioration is exhibited, polyballs will be replaced. If maintenance is required in areas where polyballs could be damaged, polyballs will be temporarily removed or moved aside. Procedures will be in place to ensure that maintenance personnel do not damage polyballs. If polyballs are damaged, they will be replaced. As a preventive maintenance function, polyballs will be replaced as recommended by the manufacture. Preventive maintenance replacement will be a function of degradation due to exposure to sunlight. Accumulated rainwater will be removed from the containment area approximately every ¼ inch of rain or upon area inspection. Containment areas are designed to gravity drain rainwater to a central location that contains a control valve.

Other passive controls include an ammonia unloading pad and collection sump that will be designed to direct and contain spills if they were to occur during ammonia loading operations.

Active controls are an essential element of this system. Since the facility is unmanned, it will be important that ammonia vapor sensors, pressure sensors, and other system variables be actively monitored and controlled. The continuous active monitoring will provide the necessary data to initiate immediate inspections and/or immediate emergency shutdown of the ammonia system. The control system will be designed so that when specific problems occur, the system shuts itself down in a manner designed to reduce the opportunity for releases to occur (i.e. the ammonia pumps shut down). In addition, sensors connected to alarms will be in place to detect releases of ammonia, which will also trigger a shutdown of the ammonia system. A brief list of ammonia-related process safety equipment features are provided below:

Ammonia System Safety Feature List
Visual low level & high pressure alarms (storage tank)
Pressure relief valves (storage tank)
Visual high liquid level alarm (Storage Tank)
Ammonia Sensors (low alarm at 25ppm, high alarm at 75ppm)
Pump discharge pressure gauge
Local and remote pressure, temperature and flow indicators & controls
Remote isolation valves
Visual low flow/pressure alarms
Local and remote pressure, temperature and flow indicators

Note: Specific system equipment, valves, control logic, capacities and other process related equipment is detailed in the RMP Technical Document, which will be maintained on-site. The major features of the process safety equipment and administrative safety procedures are described in the next section.

3.3 Process Safety Equipment

The ammonia-related process equipment will be part of the facility's NOx emission control system and is monitored by local and/or remote indicators to verify proper equipment operation. Audible alarms may also be activated by low ammonia tank level, high tank pressure, high/low vaporizer pressure, and low ammonia flow. Automated and operator controls that will be in place for the ammonia handling process to assure rapid shutdown if an ammonia release is detected. If there is a line rupture, the system will automatically shut off the flow of ammonia (i.e., pumps would be turned off and valves would be closed). If not detected through abnormalities in the operating conditions, a minor leak would be detected by strategically placed ammonia sensors. Ammonia alarms in excess of 75ppm for a specified amount of time would initiate emergency shutdown of the ammonia system.

3.4 Administrative Safety Procedures

The Chula Vista facility will be unmanned and remotely operated by PG&E-DG control center personnel and a roving regional manager. PG&E-DG personnel will routinely inspect, service, and maintain the facility. It is anticipated that operations and maintenance personnel would visit the facility 2 to 3 times per week. Vehicular traffic would be limited to operations and maintenance vehicles and aqueous ammonia deliveries. The roving regional manager will conduct walk-down safety inspections at the facility in accordance with on-site safety procedures. The walk-down inspections will be conducted every time aqueous ammonia is delivered to the site or once per month. During the first six months of operation, it is expected that site walks will be performed more regularly. PG&E-DG will conduct safety reviews as part of its periodic independent audits.

The process maintenance program will be largely based on the information provided by the system manufacturer. A maintenance team will be assembled for major routine maintenance. For either immediate attention or scheduled "outages" of the ammonia systems an emergency maintenance team or subcontractor will be utilized.

Standard Operating Procedures (SOP) for start-up and shut down operations will be reviewed and updated every two years. Changes to the SOP's may occur during operator re-qualification, or anytime changes to equipment, and procedures are made in accordance with PG&E-DG management policies. Specific ammonia process SOPs and piping and instrumentation diagrams for the ammonia system will be included in the RMP Technical Document maintained at the facility. A list of specific SOP's that relate to the ammonia system is provided below:

Administrative SOP's

- Site Inspection procedures checklists
- Corrective action work orders
- Scheduled outage overhauls
- Valve maintenance program
- Sensor maintenance program
- Operator and Emergency Coordinator safety training program
- Overall facility security procedures
- Emergency response procedures

3.5 Safety Training

All PG&E-DG regional managers that will be directly involved with the ammonia system will be trained in the physical characteristics of aqueous ammonia, the effects on the human body, the basic first aid for exposure, the safety work practices and procedures, and the available safety equipment. Drills on the emergency response plan will be held annually. All regional manager and Emergency Coordinator safety training programs implemented by PG&E-DG will follow guidelines issued by the company including hazardous materials, safe operating procedures, and other maintenance and management practices that relate to their duties at the facility.

All Emergency Coordinators will have completed a formal qualification program and will be requalified every bi-annually. Qualification will be demonstrated through written and oral examinations. The training program will be designed to facilitate effective employee response to emergencies at the facility. In the event of a fire, chemical release or other emergency at the facility, the Chula Vista Fire Department and County hazardous materials release responders have Incident Command Responsibilities. The PG&E-DG Emergency Coordinator will work with the local Fire Department, contracted emergency responders, and the County hazardous materials release responders within the Incident Command System (ICS). The facility's emergency response plan is described in greater detail in Section 9.0 of this public document.

3.6 Planned Implementation

The facility's ammonia-associated equipment, including storage vessels, supply lines, injection grid, and SCR injector are currently scheduled to be installed the end of 2000. The administrative safety procedures and associated equipment described in this section will be fully implemented when the system is installed and aqueous ammonia is delivered. Initial ammonia deliveries are not currently expected until the first quarter of 2001. Recommendations made, as part of this RMP review for CalARP will also be implemented as identified by the DEH.

SECTION 4.0
RMP OFFSITE CONSEQUENCE ANALYSIS COMPONENT

4.1 Introduction

In this section, the offsite consequence analysis (OCA) component of the RMP is provided. The analysis follows requirements of the California Accidental Release Program (CalARP). PG&E Dispersed Generating Co., LLC has completed an OCA for its proposed peak load electrical power plant in Chula Vista, California.

The purpose of the OCA is to provide information to the public on the potential off-site consequences of an accidental release of aqueous ammonia. Aqueous ammonia (19% concentration by weight) will be used with Selective Catalytic Reduction (SCR) technology to control NO_x emissions. Aqueous ammonia is the only CalARP regulated substance to be used at the proposed facility. The proposed facility qualifies for a state-only RMP since more than 500 lbs. of aqueous ammonia will be stored on-site. The facility does not qualify for the federal U.S. Environmental Protection Agency (USEPA) RMP (40 CFR 68). The federal RMP aqueous ammonia usage threshold is 20,000 lbs, which is greater than the aqueous ammonia amount that will be stored on-site. In addition, the federal RMP does not require an OCA for aqueous ammonia with a concentration less than 20% by weight.

A primary objective of the OCA is to determine the maximum distance from the release location to a toxic endpoint, which in this case is any point around the facility where the concentration of ammonia reaches the threshold level for serious injury from exposure. The toxic endpoint specified by the federal regulations for ammonia is 0.14 milligrams per liter (mg/l) or 200 ppmw[1]. Under CalARP provisions, the process whereby aqueous ammonia is stored and used is considered a Prevention Program 2 process. As such the facility operator is required to analyze both:

- a worst-case release scenario, and
- one or more alternative release scenarios.

The conditions assessed under the worst-case scenario are clearly defined in CalARP. The worst-case scenario involves the complete loss of the greatest amount that can be held in a vessel or pipe, taking into account administrative controls that may limit the maximum quantity. This worst-case release must be analyzed, even if there is no credible series of events that could lead to such a release. The loss is assumed to occur over 10 minutes, with worst-case meteorology prevailing at the time of release. Credit can be taken for passive mitigation features (such as a physical enclosure), but not for active features (such as human intervention).

In contrast to the worst-case release scenario, an alternative release scenario for a process covered by CalARP is one which is:

- more likely to occur than the worst-case scenario, and
- capable of reaching the ammonia endpoint at an offsite location.

[1] This equates to 140 milligrams ammonia per cubic meter or air (mg/m^3) and 200 parts ammonia per million parts of air (ppm).

The alternative release scenario is based on a combination of reasonable assumptions; however, it is not necessary to estimate the probability of occurrence, or even to perform analyses which show it is more likely than the worst-case scenario. Within the assessment for the alternative release scenario, credit can be taken for active as well as passive mitigation systems, provided that the mitigation systems are capable of withstanding the event that is assumed to cause the release. Average meteorology (rather than worst-case) is used in the alternative release scenario assessment.

A worst-case and alternative release scenario have been developed and analyzed in accordance with methods and assumptions contained in the documents "CalARP Guidelines" (HMD 1999), and "Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Releases" (EPA 1993). The release scenarios and associated data, assumptions, and calculations are described in this section. The elements of the worst-case and alternative release scenarios, and the input data and results of the offsite consequence modeling scenarios are presented in Table 4-1. Figure 4-1 is a map of the vulnerability zone for the worst-case scenario. Figure 4-2 is a map of the vulnerability zone for the alternative scenario. Appendix A contains emission rate calculation examples using EPA guidance (EPA 1993). Appendix B contains vapor pressure data for aqueous ammonia solutions (Perry 1963). Appendix C contains dispersion modeling results and selected source term calculations for the worst-case scenario. Appendix D contains dispersion modeling results and selected source term calculations for the alternative scenario.

Table 4-1: OCA Data, Methods, and Results

	Units	Worst-Case Scenario	Alternative Scenario
Model Input Data			
Chemical [a]	---	Aqueous ammonia (29%)	Aqueous ammonia (29%)
Release Form	---	Liquid	Liquid
Dispersion Model	---	AFTOX Version 4.1	AFTOX Version 4.1
Dispersion Algorithm	---	Neutrally Buoyant	Neutrally Buoyant
Release Quantity	gal.	12,000	52.4
Release Rate	gal./min.	1,200	104.8
Release Time	min.	10	0.5
Surface Area of Spill	sq. meters	11.59 [b]	19.85 [c]
Release Temperature	°F	96.8	62.1
Release Pressure	psig	N/A	N/A
Relative Humidity	percent	N/A	N/A
Stability Class [d]	---	F	C / D
Wind Speed	m/s	1.5	2.86
Cloud Cover	percent	50	0
Surface Roughness	cm	50	50
Concentration Averaging Time	min.	10	10
Level of Concern	ppm	200	200
Results (Zone of Vulnerability)			
Distance to Endpoint [e]	feet	213.5	85.1
Public Receptors Present?	---	No	No
Ecological Receptors Present?	---	No	No
Major Commercial, Office, Industrial Areas Present?	---	No	No

N/A = not applicable

a. Modeled using 29% aqueous ammonia (conservative approach) since AFTOX has detailed chemical properties for this concentration. Note that aqueous ammonia on-site at PG&E facility will only be 19% by weight.

b. Area of spill includes concrete containment surface area of 624 ft^2 (16' by 39') with 100% polyball coverage, which provides 80% reduction in liquid surface area. Therefore, maximum surface area is 124.8 ft^2.

c. Area of spill includes low-lying concrete catch basin that contains 52.4 gallons (100 gpm flow for 30 seconds and contents of a 15' long pipe of 2" in diameter) of ammonia to a depth of 1 cm.

d. The minimum distance from the center of the spill to the fence-line is 129' for the worst-case scenario and 127' for the alternative scenario.

4.2 Worst-Case Release Scenario

The worst-case release scenario source-term (ammonia release rate) calculations, modeling methodology, and results are described below. Selected source term calculations and dispersion modeling outputs are provided in Appendix C.

Event

Catastrophic breach of a 12,000-gallon capacity aqueous ammonia tank occurs. All contents of tank instantaneously spill into a concrete containment area (16 feet wide, 39 feet long, 2.75 feet tall) which has a surface area of 624 ft^2. The area of the spill is further reduced by floating polyballs, which cover the surface of the spill and provide an 80% reduction of the spill surface area. Therefore, the surface area of the spill is 124.8 ft^2 (11.6 m^2).

Chemical name and physical state

Aqueous ammonia (19% by weight) stored as a liquid.

Toxic Endpoint

The toxic endpoint for ammonia is 0.14 mg/l (140 mg/m^3 or 200 ppm).

Offsite consequence analysis methods

To estimate the furthest distance to the ammonia endpoint, the United States Air Force Toxic Chemical Dispersion Model (AFTOX) Version 4.1 was used. The AFTOX model will determine toxic chemical concentrations and give the user the option of calculating a toxic corridor, the concentration at a specific location, or the maximum concentration and its location. AFTOX was developed for real-time analysis of neutrally-buoyant, toxic chemical releases. AFTOX has wide applicability. Unlike many methods developed for specific situations, AFTOX can be used equally for all atmospheric stability conditions and release scenarios. Because AFTOX does not have detailed chemical properties for ammonia concentrations of 19% (ammonia to be used by proposed PG&E facility), a 29% aqueous ammonia solution was modeled using AFTOX.

For the worst-case scenario, AFTOX was used to calculate the distance to the toxic endpoint of ammonia from an accidental release. The distance to the toxic endpoint calculated by AFTOX was then scaled against an emission rate determined using EPA guidance (EPA 1993). The goal of the scaling was to provide an adjusted toxic endpoint distance representative of the highest emission rate from either AFTOX or the EPA guidance. An example of the EPA emission rate calculation is attached in Appendix A. Aqueous ammonia vapor pressure (Perry 1963) used in this calculation is attached in Appendix B. Aqueous ammonia data for a 19.1% ammonia solution was used in the EPA emission rate calculation.

It is assumed that the ammonia emission rate and thus the modeled concentration is linearly proportional to the distance to the toxic endpoint (i.e. $D_{EPA} = D_{AFTOX} \times (E_{EPA}/ E_{AFTOX})$ where D is distance to the ammonia toxic endpoint of 200 ppm and E is emission rate). In reality, the ammonia concentration decrease with distance would be exponential and non-linear. Thus, near the source location, the concentration rate of decrease (ppm/meter) will actually be much greater than the linear relationship is assumed. Therefore, assuming a linear relationship between emission rate and distance to endpoint is highly conservative.

For the worst-case scenario, D_{EPA} = 48 m x (2.59 lb/min / 1.91 lb/min) = 65.1 m (213.5 feet) to the ammonia toxic endpoint of 200 ppm. The distance to the toxic endpoint slightly extends beyond the minimum distance from the center of the ammonia release to the facility fence-line (129'). Therefore, the facility is classified as Program 2.

Scenario Description

Ammonia for the selective catalytic reduction (SCR) air pollution control system is stored at this facility in an outdoor, horizontally mounted storage tank. The tank has a maximum capacity of 12,000 gallons water volume. The tank is limited to approximately 85% fill volume to allow headspace for vapor present in the tank. However, HMD has required that the worst-case scenario involve the release of 12,000 gallons. Therefore, results of this analysis are conservative. In accordance with federal rule 40 CFR 68.25(c), the entire contents of the tank are spilled instantaneously and the contents of the spill evaporate to the ambient air over a 10-minute period.

Height of release

The release is analyzed as a ground-level release.

Meteorology

The worst-case meteorological scenario involves the following conditions:

Wind speed:	1.5 m/s (3.4 mph)
Wind direction:	Any; North (0°) is used for the purpose of this analysis
Atmospheric stability:	Pasquill Class F
Temperature:	96.8° F; maximum occurring in the most recent three years; average between Brown Field and Imperial Beach NOLF (April 1997 – March 2000)
Cloud Cover:	50%
Relative Humidity:	Not applicable to AFTOX

Topography (Surface Roughness)

The assessment assumes a surface roughness of 50 centimeters.

Distance to Endpoint

The results of this analysis indicate that the distance to the toxic endpoint is 213.5 feet.

4.3 Alternative Release Scenario

The alternative release scenario source-term (ammonia release rate) calculations, modeling methodology, and results are described below. Selected source term calculations and dispersion modeling outputs are provided in Appendix D.

Event

During truck unloading operations, the transfer hose between the loading truck and ammonia tank decouples. The spill includes all contents of the transfer hose (15 feet long with 2 inch diameter) and a 30 second release of ammonia at the maximum truck transfer pump rate of 100 gallons/minute before the value shuts off. Approximately 52.4 gallons of ammonia instantaneously spill into a low-lying concrete containment area to a depth of 1 centimeter. Therefore, the surface area of the spill is 213.7 ft^2 (19.9 m^2). PG&E will use a system of containment dikes, berms, and/or sumps in the truck unloading area to ensure that the spill surface area will not exceed this maximum surface area value. Therefore, the alternative case scenario considered is conservative.

Chemical name and physical state
Aqueous ammonia (19% by weight) stored as a liquid.

Toxic Endpoint
The toxic endpoint for ammonia is 0.14 mg/l (140 mg/m^3 or 200 ppm).

Offsite consequence analysis methods
To estimate the furthest distance to the ammonia endpoint, the United States Air Force Toxic Chemical Dispersion Model (AFTOX) Version 4.1 was used. The AFTOX model will determine toxic chemical concentrations and give the user the option of calculating a toxic corridor, the concentration at a specific location, or the maximum concentration and its location. AFTOX was developed for real-time analysis of neutrally-buoyant, toxic chemical releases. AFTOX has wide applicability. Unlike many methods developed for specific situations, AFTOX can be used equally for all atmospheric stability conditions and release scenarios. Because AFTOX does not have detailed chemical properties for ammonia concentrations of 19% (ammonia to be used by proposed PG&E facility), a 29% aqueous ammonia solution was modeled using AFTOX.

Following emission rate methods used for the worst-case scenario, AFTOX was used to calculate the distance to the toxic endpoint of ammonia from an accidental release. The distance to the toxic endpoint calculated by AFTOX was then scaled against an emission rate determined using EPA guidance (EPA 1993). The goal of the scaling was to provide an adjusted toxic endpoint distance representative of the highest emission rate from either AFTOX or the EPA guidance. An example of the EPA emission rate calculation is attached in Appendix A. Aqueous ammonia vapor pressure (Perry 1963) used in this calculation is attached in Appendix B. Aqueous ammonia data for a 19.1% ammonia solution was used in the EPA emission rate calculation.

It is assumed that the ammonia emission rate and thus the modeled concentration is linearly proportional to the distance to the toxic endpoint (i.e. $D_{EPA} = D_{AFTOX} \times (E_{EPA}/ E_{AFTOX})$ where D is distance to the ammonia toxic endpoint of 200 ppm and E is emission rate). In reality, the ammonia concentration decrease with distance would be exponential and non-linear. Thus, near the source location, the concentration rate of decrease (ppm/meter) will actually be much greater than if a linear relationship is assumed. Therefore, assuming a linear relationship between emission rate and distance to endpoint is highly conservative.

For the alternative scenario, D_{EPA} = 34 m x (3.25 lb/min / 4.26 lb/min) = 25.9 m (85.1 feet) to the ammonia toxic endpoint of 200 ppm. Therefore, the distance to the toxic endpoint is located completely on-site.

Scenario Description
During truck unloading operations, the transfer hose between the loading truck and ammonia tank decouples. Approximately 52.4 gallons of ammonia instantaneously spill into a low-lying concrete containment area to a depth of 1 centimeter. The contents of the spill evaporate to the

ambient air over a 30-second period.

Height of release
The release is analyzed as a ground-level release.

Meteorology
The average meteorological scenario involves the following conditions:

Wind speed:	2.86 m/s or 6.4 mph (i.e. the average annual wind speed at Imperial Beach station (CARB 1992))
Wind direction:	Any; North (0°) is used for the purpose of this analysis
Atmospheric stability:	Pasquill Class C / D
Temperature:	62.1° F (average monthly temperature occurring in the most recent three years; average between Brown Field and Imperial Beach NOLF (April 1997 – March 2000)
Cloud Cover:	0%
Relative Humidity:	Not applicable to AFTOX

Topography (Surface Roughness)
The assessment assumes a surface roughness of 50 centimeters.

Distance to Endpoint
The results of this analysis indicate that the distance to the toxic endpoint is 85.1 feet.

4.4 Estimation or Population and Environmental Receptors

4.4.1 Worst-Case Scenario
The worst-case scenario is used as required by the Rule to outline a "vulnerability zone" which is the area within a circle defined by a 213.5 foot radius originating from the center of the ammonia tank containment area (Figure 4-1).

Total Estimated Residential Population
There are no persons residing in the worst-case scenario vulnerability zone. This estimate is derived by aerial photography analyses and visual inspection at the proposed site.

Presence of Public Receptors
No public receptors are known to be present within the worst-case scenario vulnerability zone.

Ecological Receptors
No ecological receptors are located within the worst-case scenario vulnerability zone.

4.4.2 Alternative Scenario
The alternative scenario vulnerability zone is the area within a circle defined by a 85.1 foot radius originating at the center of the low-lying concrete catch basin that contains the spill from the alternative release (Figure 4-2).

Total Estimated Residential Population

There are no persons residing in the alternative scenario vulnerability zone. The vulnerability zone for the alternative scenario is located completely on-site.

Presence of Public Receptors
No public receptors are known to be present within the alternative scenario vulnerability zone.

Ecological Receptors
No ecological receptors are located within the alternative scenario vulnerability zone.

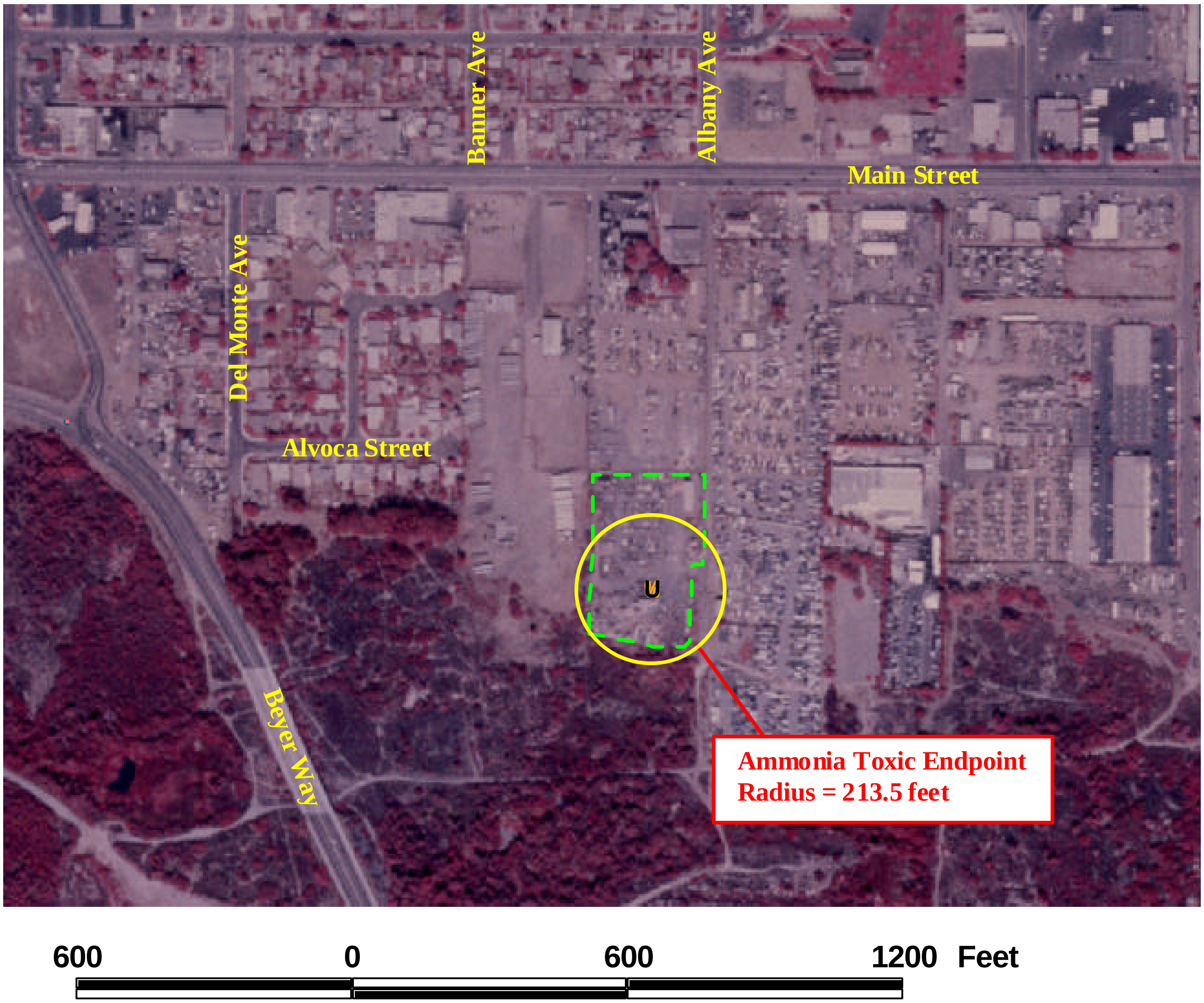
4.5 References

CARB 1992. California Air Resources Board, California Surface Wind Climatology, Reprinted 1992.

EPA 1993. U.S. Environmental Protection Agency, Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Releases EPA-454/R-93-002, May.

HMD 1999. San Diego County Dept. of Environmental Health Hazardous Materials Division, CalARP Guidelines, Revised February 25.

Perry, J.H., Chemical Engineers' Handbook, McGraw-Hill, New York, 1963. (Chapter 3.)



U Center of Containment Area

PG&E Fenceline

Ammonia Toxic Endpoint is 200 ppmw (0.14 mg/L)

Figure 4-1	**Worst-Case Ammonia Impact** PG&E Dispersed Generating, LLC Offsite Consequence Analysis Proposed Chula Vista, CA Site	N W E S

500 0 500 1000 1500 Feet

Center of Containment Area

PG&E Fenceline

Ammonia Toxic Endpoint is 200 ppmw (0.14 mg/L)

Figure 4-2	**Alternative Case Ammonia Impact** PG&E Dispersed Generating, LLC Offsite Consequence Analysis Proposed Chula Vista, CA Site	N W E S

APPENDIX A

EPA EMISSION RATE CALCULATION EXAMPLE (EPA 1993)

Emission Rate Calculation Examples Using EPA Guidance (EPA 1993)

1) EPA Emission Rate Equations

- Evaporation rate for aqua ammonia solution, E_{pool}:

$$E_{pool} = 6.94x10^{-7}(1 + 0.0043(T_{rel} - 273.15)^2)U_r^{0.75}A_pM\frac{p_v}{p_{vh}}$$

where,

E_{pool} = pool emission rate for aqua ammonia solution (kg/s)
T_{rel} = release temperature (deg K)
U_r = ambient wind speed (m/s)
A_p = surface area of pool (m^2)
M = molecular weight (kg/kmol)
p_v = total vapor pressure of aqua ammonia solution at T_{rel} (Pa)
p_{vh} = vapor pressure of hydrazine at T_{rel} (Pa)

- Emission rate for the ammonia portion of the aqua ammonia solution, E_{NH3}:

$$E_{NH3} = \left(\frac{p_v(NH3)}{p_v}\right)\left(\frac{M_{NH3}}{M_T}\right)E_{pool}$$

where,

E_{NH3} = pool emission rate for ammonia (kg/s)
$p_v(NH3)$ = partial pressure of ammonia vapor over aqua ammonia solution at T_{rel} (Pa)
p_v = total vapor pressure of aqua ammonia solution at T_{rel} (Pa)
M_{NH3} = molecular weight of ammonia (kg/kmol)
M_T = average molecular weight of the water vapor and ammonia mixture (kg/kmol)

- Conversion between kg/s and lbs/min

$$\left(\frac{kg}{s}\right)\bullet\left(\frac{3600s}{min}\right)\left(\frac{1000g}{kg}\right)\left(\frac{lb}{453.59g}\right) = \left(\frac{lb}{min}\right)$$

2) Worst-Case Scenario Calculations

T_{rel} = 309.15 deg K
U_r = 1.5 m/s
A_p = 11.59 m^2
M = 17.03 kg/kmol

$p_v = 62{,}115$ Pa
$p_{vh} = 3{,}616$ Pa
$p_v(NH3) = 58{,}203$ Pa
$M_{NH3} = 17.03$ kg/kmol
$M_T = 17.09$ kg/kmol

$$E_{pool} = 6.94x10^{-7}(1 + 0.0043(309.15 - 273.15)^2)(1.5^{0.75})(11.59)(17.03)\left(\frac{62{,}115}{3{,}616}\right)$$

$$= 0.0210\,\text{kg/s}\left(\frac{60\text{s}}{\text{min}}\right)\left(\frac{1000\text{g}}{\text{kg}}\right)\left(\frac{\text{kg}}{453.59\text{g}}\right) = 2.77\frac{\text{lb}}{\text{min}}$$

and,

$$E_{NH3} = \left(\frac{58{,}203\text{ Pa}}{62{,}115\text{ Pa}}\right)\left(\frac{17.03\text{ kg/kmol}}{17.09\text{ kg/kmol}}\right)2.77\frac{\text{lb}}{\text{min}} = 2.59\frac{\text{lb}}{\text{min}}$$

3) Alternative Scenario Calculations

$T_{rel} = 289.87$ deg K
$U_r = 2.86$ m/s
$A_p = 19.85\ m^2$
$M = 17.03$ kg/kmol
$p_v = 26{,}561$ Pa
$p_{vh} = 1{,}147$ Pa
$p_v(NH3) = 24{,}913$ Pa
$M_{NH3} = 17.03$ kg/kmol
$M_T = 17.09$ kg/kmol

$$E_{pool} = 6.94x10^{-7}(1 + 0.0043(289.87 - 273.15)^2)(2.86^{0.75})(19.85)(17.03)\left(\frac{26{,}561}{1{,}147}\right)$$

$$= 0.0263\,\text{kg/s}\left(\frac{60\text{s}}{\text{min}}\right)\left(\frac{1000\text{g}}{\text{kg}}\right)\left(\frac{\text{kg}}{453.59\text{g}}\right) = 3.48\frac{\text{lb}}{\text{min}}$$

and,

$$E_{NH3} = \left(\frac{24{,}913\text{ Pa}}{26{,}561\text{ Pa}}\right)\left(\frac{17.03\text{ kg/kmol}}{17.09\text{ kg/kmol}}\right)3.48\frac{\text{lb}}{\text{min}} = 3.25\frac{\text{lb}}{\text{min}}$$

For a source-term model, the two values of t_d also are sufficiently long to treat this as a continuous release for most receptors.

5.8.5 Release-class-specific Calculations

The flow chart showing the calculations of input for a single-phase low volatility liquid release is presented n Figures 4-5 and 4-6.

5.8.6 Determination of Choked Flow for Gas Releases

This determination is not required since it is a low volatility liquid release.

5.8.7 Emission Rate

There are two emission rates of importance in a low volatility liquid release. The first is the emission rate of the liquid as it releases from the container. The second is the evaporation rate from the pool that forms. These two emission rates must be compared to determine which one is the limiting emission.

To calculate the emission rate from the container, the same technique is followed as for a high volatility spill (Section 4.7.7). First, the storage pressure (p_{sv}) must be calculated using:

$$p_{sv} = 101325\text{Pa}\ \exp\left[\frac{\lambda M}{R}\left(\frac{1}{T_b} - \frac{1}{T_s}\right)\right]$$

$$p_{sv} = 101325\text{Pa}\ \exp\left[\frac{(2.3549\text{x}10^6\text{J/kg})(21.24\text{kg/kmol})}{(8314\text{J/kmol}^\circ\text{K})}\left(\frac{1}{370.2^\circ\text{K}} - \frac{1}{291.48^\circ\text{K}}\right)\right]$$

$$= 1.2579\text{x}10^3\text{Pa}$$

Next, the pressure at the exit hole must be calculated. This is done by the equation:

$$P_h = \max(p_a, p_{sv}) + \rho_s g H_l$$

or, in this example,

$$P_h = 1.01325\text{x}10^5\text{Pa} + (993.30\text{kg/m}^3)(9.806\text{m/s}^2)(2.44\text{m})$$

$$= 1.2509\text{x}10^5\text{Pa}$$

Since the storage pressure (p_{sv}) is less than the ambient pressure (p_a), the maximum is taken as 1 atm. Also note that the stored liquid density is assumed to be that at the normal boiling point, rather than at the storage temperature. This assumption was made as a matter of convenience instead of approximating through extrapolation of the actual liquid density using assumed temperature dependencies. The error is probably minimal in comparison to other assumptions in the emission rate calculation.

The term β (as defined in Section 4.7.7) approaches zero in this release from a tank since the area of the hole is very much smaller than the area of the tank. This means that K is equal to C (0.65). The equation in Section 4.7.7 can then be written as:

$$E = CA_o[2\rho_s(p_h - p_a)]^{\frac{1}{2}}$$

and

$$E = (0.65)(2.85 \times 10^{-4} m^2)$$

$$[2(993.30 kg/m^3)((1.2509 \times 10^5 Pa) - (1.01325 \times 10^5 Pa))]^{\frac{1}{2}}$$

$$= 1.273\ kg/s$$

Finally, the maximum pool evaporation rate must be calculated and compared to the container emission rate. Whichever emission rate is the smaller is the limiting emission rate. The pool evaporation rate (E_{pool} in Section 4.7.8) is calculated from:

$$E_{pool} = 6.94 \times 10^{-7}(1 + 0.0043(T_{rel} - 273.15)^{2})U_r^{0.75} A_p M \frac{p_v}{p_{vh}}$$

Before E_{pool} can be calculated, three parameters must be known. One of the parameters, release temperature (T_{rel}), is determined in Section 5.8.8 as 291.48 °K. The other two, p_v and p_{vh}, need to be calculated here. As discussed in Section 4.7.8, the emission E_{pool} should be calculated at both T_{rel} and T_a; the larger value of E_{pool} should then be used. In this example, however, T_{rel} and T_a are the same, so only one calculation is required.

The parameter p_v is the vapor pressure of the entire hydrochloric acid solution. It is the sum of the partial pressures of the water vapor and the anhydrous hydrogen chloride over the solution. The pool emission rate must be compared to the liquid emission rate from the container. Since the liquid is made up of both water and hydrogen chloride, the pool emission rate should take into account both species. From the data base, at T_{rel}:

$$p_v(HCl) = 1274.2 Pa$$
$$p_v(H_2O) = 655.8 Pa$$
$$p_v = 1930.0 Pa$$

If this were not a mixture, the parameter p_v is calculated from the equation:

$$p_v = 101325\text{Pa}\ \exp\left[\frac{\lambda M}{R}\left(\frac{1}{T_b} - \frac{1}{T_{rel}}\right)\right]$$

The parameter p_{vh} is the vapor pressure of hydrazine at T_{rel}. It can be calculated from:

$$p_{vh} = \exp\left[76.8580 - \frac{7245.2}{T_{rel}} - 8.22\ln(T_{rel}) + 0.0061557T_{rel}\right]$$

$$= \exp\left[76.8580 - \frac{7245.2}{291.48°K} - 8.22\ln(291.48°K)\right.$$

$$\left. + 0.0061557(291.48°K)\right]$$

$$= 1270.8\text{Pa}$$

This makes the value of E_{pool}:

$$E_{pool} = 6.94x10^{-7}(1 + 0.0043(291.48°K - 273.15°K)^{*2})(2.24m/s)^{0.75}$$
$$(53.54m^2)(21.24kg/kmol)\frac{1930.0\text{Pa}}{1270.8\text{Pa}}$$

which gives a value of 0.005365 kg/s. Thus, E_{pool} is less than E. The pool size is at its maximum of 53.54 m^2. An important point about the emission rate is that it includes the emissions of both water vapor and hydrogen chloride. The actual emission rate used in a model should be for the hydrogen chloride alone. The emission rates of the water and hydrogen chloride vapors are in the same ratio as their weight per cent ratio. This means that the hydrogen chloride emission rate (E_{HCl}) can be calculated using:

$$E_{HCl} = \left(\frac{p_v(HCl)}{p_v}\right)\left(\frac{M_{HCl}}{M_T}\right)E_{pool}$$

$$E_{HCl} = \left(\frac{1274.2Pa}{1930.0Pa}\right)\left(\frac{36.461kg/kmol}{30.23kg/kmol}\right)(0.005365kg/s)$$

$$= 0.004272kg/s$$

where: M_{HCl} = molecular weight of hydrogen chloride (36.46 kg/kmol); and

M_T = average molecular weight of the water vapor and hydrogen chloride mixture.

$$M_T = \left(\frac{p_v(HCl)}{p_v}\right)M_{HCl} + \left(\frac{p_v(H_2O)}{p_v}\right)M_{H_2O}$$

$$= \left(\frac{1274.2Pa}{1930.0Pa}\right)(36.46kg/kmol) + \left(\frac{655.8Pa}{1930.0Pa}\right)(18.02kg/kmol)$$

$$= 30.19kg/kmol$$

5.8.8 Release Temperature

The liquid is released at its storage temperature. For a conservative approach, the release temperature should be assumed to be either the storage or ambient temperature, whichever is higher. Both of these temperatures are the same in this example, so the release temperature (T_a) is assumed to be 291.48 °K.

5.8.9 Vapor Fraction

The value of F_{rel} was determined to be zero in the process of determining the release class (Section 5.8.3). That is, no flashing occurred.

5.8.10 Initial Concentration

The method for calculating initial concentration is given in Section 4.10.2. The release in the current example has all three components

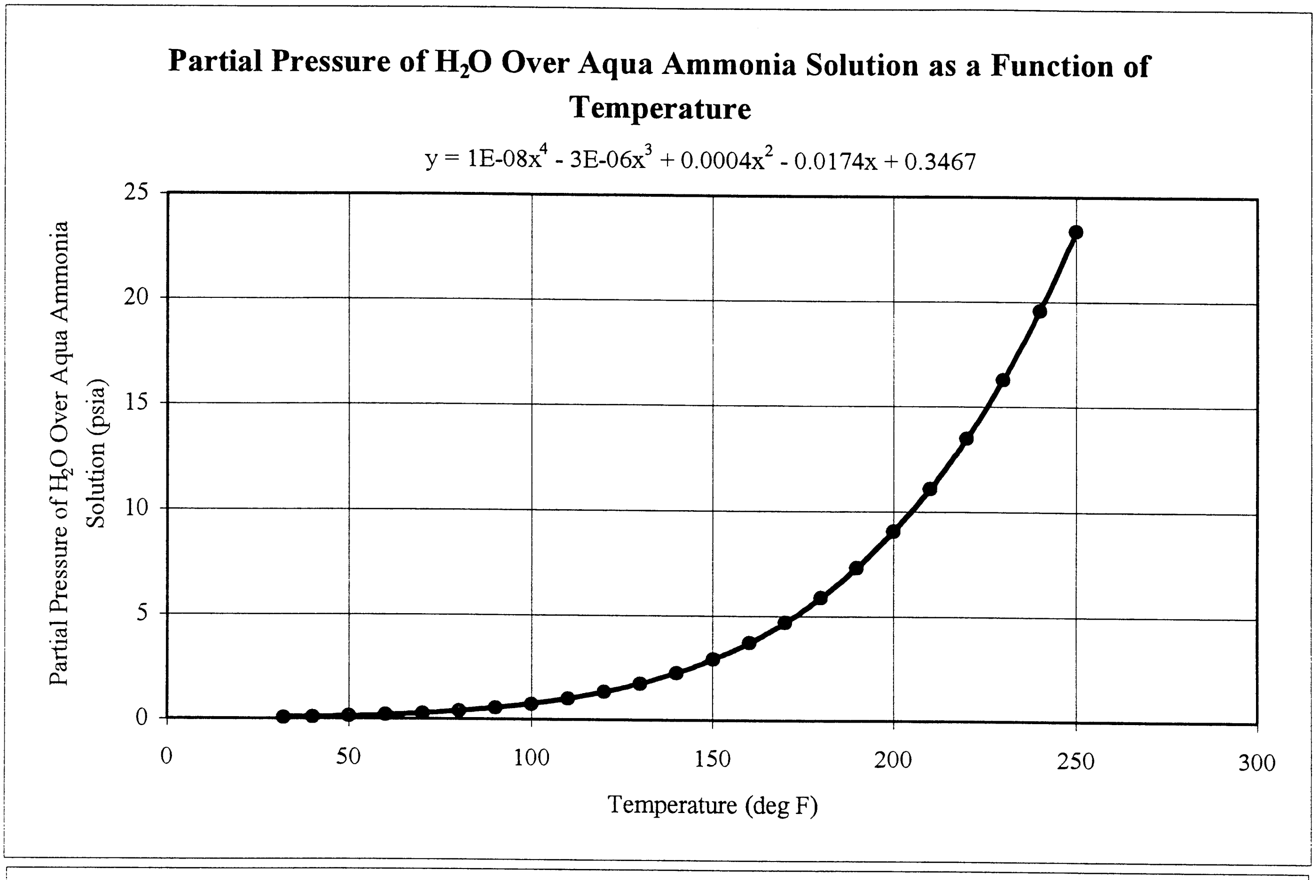
APPENDIX B

VAPOR PRESSURE DATA FOR AQUEOUS AMMONIA SOLUTIONS (Perry 1963)

Aqua Ammonia Vapor Pressure Data [1]

Temp. (Deg F)	Partial Pressure of H_2O Over Aqueous Soultion of Ammonia (psia)	Partial Pressure of NH_3 Over Aqueous Soultion of Ammonia (psia)	Total Vapor Pressure of Aqueous Solution of NH_3 (psia)
32	0.07	1.51	1.58
40	0.095	1.92	2.01
50	0.14	2.53	2.67
60	0.20	3.21	3.51
70	0.28	4.28	4.56
80	0.40	5.45	5.85
90	0.55	6.88	7.43
100	0.74	8.60	9.34
110	1.00	10.64	11.64
120	1.33	13.09	14.42
130	1.74	15.93	17.67
140	2.26	19.23	21.49
150	2.91	23.09	26.00
160	3.71	27.45	31.16
170	4.70	32.41	37.11
180	5.89	38.13	44.02
190	7.32	44.49	51.81
200	9.04	51.58	60.62
210	11.07	59.65	70.72
220	13.48	68.43	81.91
230	16.29	78.14	94.43
240	19.58	89.02	108.60
250	23.39	100.69	124.08

[1] Data from Perry's Chemical Engineers Handbook for 19.1% by weight solution of aqua ammonia


Partial Pressure of H2O Over Aqua Ammonia Solution as a Function of Temperature
y = 1E-08x4 - 3E-06x3 + 0.0004x2 - 0.0174x + 0.3467
Partial Pressure of H2O Over Aqua Ammonia Solution (psia)
25
20
15
10
5
0
0
50
100
150
200
250
300
Temperature (deg F)

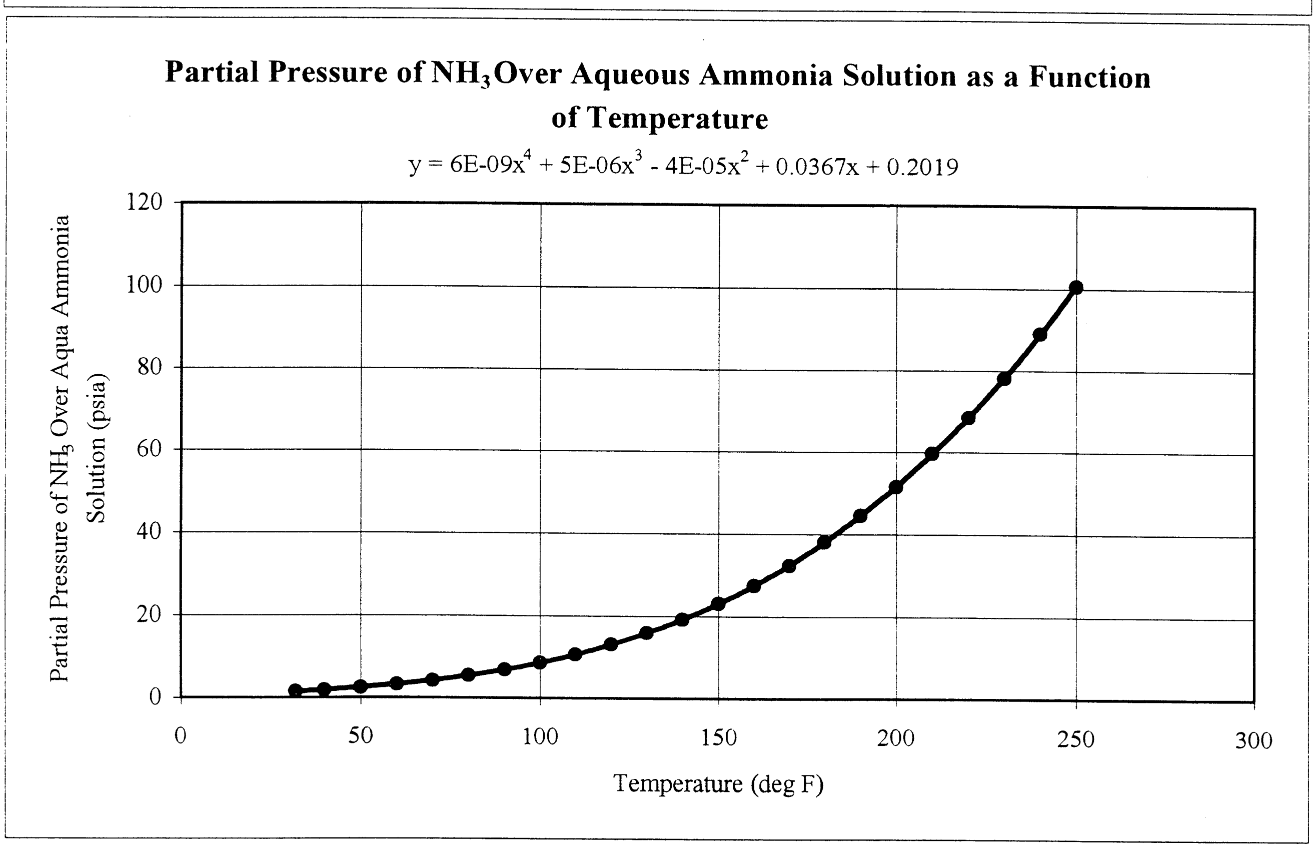

Partial Pressure of NH3 Over Aqueous Ammonia Solution as a Function of Temperature
y = 6E-09x4 + 5E-06x3 - 4E-05x2 + 0.0367x + 0.2019
Partial Pressure of NH3 Over Aqua Ammonia Solution (psia)
120
100
80
60
40
20
0
0
50
100
150
200
250
300
Temperature (deg F)

Table 3-21. Partial Pressures of H_2O over Aqueous Solutions of NH_3*

Pressures are in pounds per square inch absolute

t, °F.	Molal concentration of ammonia in the solutions in percentages (Weight concentration of ammonia in the solution in percentages)																			
	0 (0)	5 (4.74)	10 (9.50)	15 (14.29)	20 (19.10)	25 (23.94)	30 (28.81)	35 (33.71)	40 (38.64)	45 (43.59)	50 (48.57)	55 (53.58)	60 (58.62)	65 (63.69)	70 (68.79)	75 (73.91)	80 (79.07)	85 (84.26)	90 (89.47)	95 (94.72)
32	0.09	0.084	0.079	0.074	0.070	0.065	0.060	0.056	0.051	0.047	0.042	0.038	0.034	0.030	0.025	0.021	0.017	0.013	0.008	0.004
40	.12	.115	.108	.101	.095	.089	.083	.076	.070	.064	.058	.052	.046	.040	.035	.029	.023	.015	.012	.006
50	.18	.17	.16	.15	.14	.13	.12	.11	.10	.094	.085	.076	.068	.059	.051	.042	.034	.025	.017	.008
60	.26	.24	.23	.21	.20	.19	.17	.16	.15	.13	.12	.11	.097	.085	.073	.061	.049	.037	.024	.012
70	.36	.34	.32	.30	.28	.26	.25	.23	.21	.19	.17	.15	.14	.12	.10	.086	.069	.052	.034	.017
80	.51	.48	.45	.42	.40	.37	.34	.32	.29	.27	.24	.22	.19	.17	.14	.12	.096	.072	.048	.024
90	.70	.66	.63	.58	.55	.51	.47	.44	.40	.37	.33	.30	.26	.23	.20	.16	.13	[illegible]	.066	.033
100	.95	.90	.85	.79	.74	.69	.64	.59	.55	.50	.45	.41	.36	.31	.27	.22	.18	[illegible]	.090	.045
110	1.27	1.20	1.14	1.07	1.00	.93	.86	.80	.73	.67	.60	.54	.48	.42	.36	.30	.24	.18	.120	.061
120	1.69	1.60	1.51	1.42	1.33	1.24	1.15	1.06	.97	.89	.80	.72	.64	.56	.48	.40	.32	.24	.160	.081
130	2.22	2.10	1.98	1.86	1.74	1.62	1.51	1.39	1.28	1.17	1.05	.95	.84	.74	.63	.53	.42	.32	.210	.100
140	2.89	2.73	2.57	2.42	2.26	2.11	1.96	1.81	1.66	1.52	1.37	1.23	1.10	.96	.82	.69	.55	.41	.270	.140
150	3.72	3.51	3.31	3.11	2.91	2.72	2.52	2.33	2.14	1.95	1.76	1.59	1.41	1.24	1.06	.88	.71	.53	.350	.180
160	4.74	4.48	4.22	3.97	3.71	3.46	3.22	2.97	2.73	2.49	2.25	2.02	1.80	1.58	1.35	1.12	.90	.67	.450	.220
170	5.99	5.66	5.34	5.02	4.70	4.38	4.07	3.75	3.45	3.15	2.84	2.56	2.28	1.99	1.71	1.42	1.13	1.85	.570	.300
180	7.51	7.10	6.69	6.30	5.89	5.49	5.10	4.71	4.33	3.94	3.57	3.21	2.85	2.50	2.14	1.77	1.42	1.06		
190	9.34	8.83	8.32	7.82	7.32	6.83	6.34	5.86	5.38	4.91	4.44	3.99	3.55	3.10	2.65					
200	11.53	10.90	10.27	9.65	9.04	8.43	7.83	7.23	6.64	6.06	5.48	4.93	4.38	3.81						
210	14.12	13.35	12.58	11.82	11.07	10.32	9.59	8.86	8.13	7.42	6.71	6.04	5.34							
220	17.19	16.25	15.32	14.39	13.46	12.57	11.67	10.78	9.90	9.03	8.17	7.31								
230	20.78	19.64	18.51	17.40	16.29	15.19	14.11	13.03	11.97	10.91	9.87									
240	24.97	23.60	22.25	20.91	19.58	18.26	16.95	15.66	14.38	13.12	11.86									
250	29.83	28.20	26.58	25.00	23.39	21.82	20.25	18.71	17.18	15.67										

* Wilson, *Univ. Ill., Eng. Expt. Sta. Bull.* 146.

Table 3-22. Mole Percentages of H_2O over Aqueous Solutions of NH_3*

t, °F.	Molal concentration of ammonia in the solutions in percentages (Weight concentration of ammonia in the solutions in percentages)																				
	0 (0)	5 (4.74)	10 (9.50)	15 (14.29)	20 (19.10)	25 (23.94)	30 (28.81)	35 (33.71)	40 (38.64)	45 (43.59)	50 (48.57)	55 (53.58)	60 (58.62)	65 (63.69)	70 (68.79)	75 (73.91)	80 (79.07)	85 (84.26)	90 (89.47)	95 (94.72)	100 (100.00)
32	100	24.3	13.2	7.63	4.43	2.60	1.43	0.856	0.514	0.335	0.216	0.151	0.109	0.0616	0.0585	0.0457	0.0345	0.0249	0.0146	0.00689	0.00
40	100	25.3	14.1	8.15	4.73	2.74	1.59	.943	.581	.372	.248	.172	.124	.0918	.0706	.0533	.0395	.0243	.0185	.00879	
50	100	26.6	15.2	9.09	5.24	3.03	1.78	1.060	.652	.434	.290	.202	.148	.1095	.0838	.0630	.0477	.0332	.0215	.00959	
60	100	27.9	16.2	9.50	5.69	3.42	1.97	1.210	.777	.481	.331	.238	.172	.1290	.0986	.0754	.0566	.0406	.0251	.01125	
70	100	29.1	17.4	10.30	6.14	3.65	2.27	1.390	.873	.569	.383	.266	.205	.1510	.112	.0882	.0656	.0474	.0296	.0135	
80	100	31.6	18.5	11.20	6.89	4.08	2.45	1.550	.978	.659	.444	.323	.230	.1750	.130	.103	.0772	.0528	.0351	.0167	
90	100	32.7	20.0	12.00	7.40	4.47	2.73	1.730	1.100	.742	.505	.366	.267	.2020	.157	.115	.0884	.0647	.0408	.0194	
100	100	34.4	21.0	12.90	7.92	4.85	3.00	1.890	1.250	.834	.574	.420	.307	.2290	.179	.135	.104	.0714	.0473	.0226	
110	100	35.9	22.2	13.80	8.59	5.29	3.30	2.110	1.370	.932	.644	.466	.347	.2640	.208	.157	.118	.0846	.0540	.0262	
120	100	37.5	23.4	14.70	9.22	5.75	3.63	2.320	1.520	1.044	.714	.529	.395	.3020	.233	.180	.135	.0970	.0619	.0300	
130	100	39.0	24.5	15.60	9.85	6.18	3.95	2.550	1.690	1.160	.811	.596	.444	.3430	.263	.205	.154	.1117	.0703	.0339	
140	100	40.7	25.8	16.50	10.50	6.69	4.28	2.790	1.860	1.286	.906	.663	.501	.3840	.297	.232	.175	.124	.0786	.0385	
150	100	42.3	27.1	17.50	11.20	7.19	4.63	3.080	2.040	1.410	1.004	.741	.558	.4320	.334	.257	.197	.140	.0892	.0439	
160	100	44.1	28.3	18.40	11.90	7.69	5.01	3.300	2.230	1.550	1.110	.818	.617	.4800	.372	.287	.218	.154	.1005	.0499	
170	100	45.6	29.6	19.40	12.70	8.22	5.38	3.580	2.430	1.700	1.220	.904	.689	.5300	.414	.320	.242	.174	.112	.0567	
180	100	47.3	30.9	20.40	13.40	8.76	5.78	3.870	2.640	1.850	1.340	.994	.756	.5860	.456	.352	.268	.192			
190	100	48.7	32.2	21.40	14.10	9.31	6.18	4.160	2.860	2.020	1.460	1.087	.830	.6420	.501						
200	100	50.4	33.4	22.30	14.90	9.88	6.59	4.470	3.080	2.190	1.580	1.187	.907	.7010							
210	100	52.1	34.7	23.40	15.70	10.45	7.03	4.780	3.310	2.360	1.720	1.272	.983								
220	100	53.7	36.1	24.40	16.40	11.05	7.48	5.100	3.560	2.540	1.860	1.390									
230	100	55.2	37.3	25.40	17.30	11.63	7.91	5.440	3.810	2.730	2.000										
240	100	56.8	38.6	26.50	18.00	12.24	8.36	5.780	4.060	2.920	2.150										
250	100	58.4	39.8	27.50	18.80	12.88	8.82	6.120	4.340	3.120											

* Wilson, *Univ. Ill., Eng. Expt. Sta. Bull.* 146.

Table 3-23. Partial Pressures of NH_3 over Aqueous Solutions of NH_3*

Pressures are in pounds per square inch absolute

t, °F.	Molal concentration of ammonia in the solutions in percentages (Weight concentration of ammonia in the solutions in percentages)																		
	5 (4.74)	10 (9.50)	15 (14.29)	20 (19.10)	25 (23.94)	30 (28.81)	35 (33.71)	40 (38.64)	45 (43.59)	50 (48.57)	55 (53.56)	60 (58.62)	65 (63.69)	70 (68.79)	75 (73.91)	80 (79.07)	85 (84.26)	90 (89.47)	95 (94.72)
32	0.26	0.52	0.90	1.51	2.67	4.27	6.54	8.93	14.13	19.36	25.12	31.13	36.74	42.69	45.92	49.26	52.13	54.89	58.01
40	.33	.66	1.14	1.92	3.16	5.13	7.98	11.98	17.14	23.33	30.15	37.15	43.69	49.56	54.40	58.31	61.62	64.77	68.31
50	.47	.89	1.50	2.53	4.16	6.63	10.24	15.24	21.56	29.17	37.46	45.86	53.79	60.82	66.63	71.26	75.22	79.05	83.40
60	.62	1.19	2.00	3.21	5.36	8.48	13.06	19.15	26.92	36.14	46.12	56.22	65.81	73.99	80.90	86.44	91.04	95.67	100.65
70	.83	1.52	2.60	4.28	6.87	10.76	16.33	23.84	33.20	44.25	56.29	68.32	79.42	89.26	97.42	104.01	109.55	114.83	120.61
80	1.04	1.98	3.34	5.45	8.69	13.52	20.29	29.40	40.69	53.84	67.97	82.36	95.52	107.06	116.42	124.20	130.57	136.35	143.70
90	1.36	2.52	4.25	6.88	10.89	16.76	25.04	35.94	49.45	64.99	81.61	98.35	113.79	127.22	138.18	147.02	154.46	161.74	169.73
100	1.72	3.20	5.34	8.60	13.53	20.68	30.57	43.57	59.49	77.85	97.27	116.81	134.70	150.23	162.94	173.22	181.97	190.13	199.17
110	2.14	4.00	6.65	10.64	16.65	25.21	37.01	52.43	71.20	92.59	115.16	137.62	158.42	176.18	190.85	203.02	212.71	222.22	232.79
120	2.67	4.95	8.21	13.09	20.30	30.54	44.56	62.62	84.44	109.40	135.48	161.44	185.14	205.81	222.28	236.05	247.14	258.24	270.02
130	3.28	6.09	10.05	15.93	24.58	36.74	53.16	74.27	99.69	128.45	158.45	188.16	215.14	238.70	257.87	272.88	286.08	298.46	311.80
140	3.97	7.41	12.21	19.23	29.43	43.77	62.97	87.53	116.72	149.93	184.17	218.18	248.78	275.33	297.12	314.45	328.99	342.93	358.46
150	4.78	8.92	14.70	23.09	35.09	51.91	74.28	102.51	136.15	173.64	212.91	251.24	286.00	316.24	340.82	360.39	376.57	392.45	409.62
160	5.68	10.70	17.57	27.45	41.56	61.03	86.91	119.37	157.71	200.45	244.98	288.38	327.82	361.75	389.08	411.30	429.73	447.35	466.38
170	6.75	12.67	20.85	32.41	48.89	71.48	101.09	138.30	181.95	230.36	280.54	329.42	373.61	411.59	442.28	466.67	487.85	507.63	528.50
180	7.90	14.96	24.56	38.13	57.19	83.07	116.97	159.37	208.66	263.43	319.89	374.25	424.10	466.26	500.63	528.08	551.24		
190	9.23	17.55	28.78	44.49	66.49	96.22	134.89	182.72	238.39	299.86	363.11	424.15	479.40	526.15					
200	10.70	20.45	33.49	51.58	76.90	110.85	154.58	208.56	270.94	340.02	410.17	478.62	539.79						
210	12.26	23.68	38.76	59.65	88.46	126.83	176.24	236.97	307.08	383.99	462.36	537.56							
220	14.02	27.15	44.61	68.43	101.24	144.74	200.46	268.30	346.07	431.43	518.19								
230	15.95	31.09	51.06	78.14	115.45	164.17	226.67	302.53	389.29	483.53									
240	17.92	35.40	58.00	89.02	130.94	185.79	255.26	339.72	435.78	540.44									
250	20.12	40.09	65.74	100.69	147.66	209.37	286.89	380.42	486.73										

* Wilson, *Univ. Ill., Eng. Expt. Sta. Bull.* 146.

Table 3-24. Total Vapor Pressures of Aqueous Solutions of NH_3*

Pressures are in pounds per square inch absolute

t, °F.	Molal concentration of ammonia in the solutions in percentages (Weight concentration of ammonia in the solutions in percentages)																				
	0 (0)	5 (4.74)	10 (9.50)	15 (14.29)	20 (19.10)	25 (23.94)	30 (28.81)	35 (33.71)	40 (38.64)	45 (43.59)	50 (48.57)	55 (53.58)	60 (58.62)	65 (63.69)	70 (68.79)	75 (73.91)	80 (79.07)	85 (84.26)	90 (89.47)	95 (94.72)	100 (100.00)
32	0.09	0.34	0.60	0.97	1.58	2.60	4.20	6.54	9.93	14.18	19.40	25.16	31.16	36.77	42.72	45.94	49.28	52.14	54.90	58.01	62.29
40	.12	.45	.77	1.24	2.01	3.25	5.21	8.06	12.05	17.20	23.39	30.20	37.20	43.73	49.60	54.43	58.33	61.64	64.78	68.32	73.32
50	.18	.64	1.05	1.65	2.67	4.29	6.75	10.35	15.34	21.65	29.26	37.54	45.93	53.85	60.87	66.67	71.29	75.25	79.07	83.41	89.19
60	.26	.86	1.42	2.21	3.51	5.55	8.65	13.22	19.30	27.05	36.26	46.23	56.32	65.90	74.06	80.96	86.49	91.08	95.69	100.66	107.6
70	.36	1.17	1.84	2.90	4.56	7.13	11.01	16.56	24.05	33.39	44.42	56.44	68.46	79.54	89.36	97.51	104.08	109.60	114.86	120.63	128.8
80	.51	1.52	2.43	3.76	5.85	9.06	13.86	20.61	29.69	40.96	54.08	68.19	82.55	95.69	107.20	116.54	124.30	130.64	136.40	143.72	153.8
90	.70	2.02	3.15	4.83	7.43	11.40	17.23	25.48	36.34	49.82	65.32	81.91	98.61	114.02	127.42	138.34	147.15	154.56	161.81	169.76	180.6
100	.95	2.62	4.05	6.13	9.34	14.22	21.32	31.16	44.12	59.99	78.30	97.68	117.17	135.01	150.50	163.16	173.40	182.10	190.22	199.22	211.9
110	1.27	3.34	5.14	7.72	11.64	17.58	26.07	37.81	53.16	71.87	93.19	115.7	138.10	156.84	176.54	191.15	203.26	212.89	222.34	232.85	247.0
120	1.69	4.27	6.46	9.63	14.42	21.54	31.69	45.62	63.59	85.33	110.2	136.2	162.08	185.70	206.29	222.68	236.37	247.38	258.40	270.1	286.4
130	2.22	5.38	8.07	11.91	17.67	26.20	38.25	54.55	75.55	100.86	129.5	159.	189.00	215.88	239.33	258.40	273.3	286.4	298.67	311.9	330.3
140	2.89	6.70	9.95	14.63	21.49	31.54	45.73	64.78	89.19	118.24	151.3	185.4	219.28	249.66	276.15	297.81	315.0	329.4	343.2	358.6	379.1
150	3.72	8.29	12.23	17.81	26.00	37.81	54.43	76.61	104.65	138.1	175.4	214.5	252.65	287.24	317.3	341.7	361.1	377.1	392.8	409.8	432.7
160	4.74	10.16	14.92	21.54	31.16	45.02	64.25	89.88	122.10	160.2	202.7	247.0	290.18	329.4	363.1	390.2	412.2	430.4	447.8	466.6	492.8
170	5.99	12.41	18.01	25.87	37.11	53.27	75.55	104.84	141.75	185.1	233.2	283.1	331.7	375.6	413.3	443.7	467.8	488.7	508.2	528.8	558.4
180	7.51	15.00	21.65	30.86	44.02	62.68	88.17	121.68	163.7	212.6	267.0	323.1	377.1	426.6	468.4	502.4	529.5	552.3			
190	9.34	18.06	25.87	36.60	51.81	73.32	102.56	140.75	188.1	243.3	304.3	367.1	427.7	452.5	528.8						
200	11.53	21.60	30.72	43.14	60.62	85.33	118.68	161.81	215.2	277.0	345.5	415.1	483.0	543.6							
210	14.12	25.61	36.26	50.58	70.72	98.80	136.42	185.10	245.1	314.5	390.7	468.4	542.9								
220	17.19	30.27	42.47	59.00	81.91	113.81	156.41	211.24	278.2	355.1	439.6	525.5									
230	20.78	35.59	49.60	68.46	94.43	130.64	178.28	239.70	314.5	400.2	493.4										
240	24.97	41.52	57.65	78.91	108.60	149.20	202.74	270.92	354.1	448.9	552.3										
250	29.83	48.32	66.67	90.74	124.08	169.48	229.62	305.60	397.6	502.4											

* Wilson, *Univ. Ill., Eng. Expt. Sta. Bull.* 146.

APPENDIX C

WORST-CASE DISPERSION MODELING RESULTS AND CALCULATIONS

USAF TOXIC CHEMICAL DISPERSION MODEL

AFTOX

Otay (CA)

DATE: 11-21-2000
TIME: 0000 LST

INSTANTANEOUS RELEASE

AMMONIA(29%)
SHORT TERM EXPOSURE LIMIT (STEL) IS 35 PPM (24 MG M-3)
TIME WEIGHTED AVERAGE (TWA) IS 25 PPM (17 MG M-3)

TEMPERATURE = 36 C
WIND DIRECTION = 0
WIND SPEED = 1.5 M/S
NIGHTTIME SPILL
CLOUD COVER IS 4 EIGHTHS
GROUND IS DRY
THERE IS NO INVERSION
ATMOSPHERIC STABILITY PARAMETER IS 6
SPILL SITE ROUGHNESS LENGTH IS 50 CM

THIS IS A LIQUID RELEASE
TOTAL AMOUNT SPILLED IS 12000 GAL
AREA OF SPILL IS 12 SQ M
EVAPORATION RATE IS 1.91 LBS/MIN
THE CHEMICAL WILL EVAPORATE IN 46203 MIN
CONCENTRATION AVERAGING TIME IS 10 MIN
HEIGHT OF INTEREST IS 0 M

THE MAXIMUM DISTANCE FOR 200 PPM IS 48 M
MAXIMUM TOXIC CORRIDOR LENGTH = 101 M
DIRECTION & WIDTH 180 +/- 180 DEG

PG&E Dispersed Generating, LLC

Offsite Consequence Analysis - Worst-Case Scenario for Ammonia

Worst-Case Scenario Release Conditions

Worst-Case Scenario:

Catastrophic breach of aqueous ammonia tank. All contents of tank instantaneously spill into a concrete containment area. Pool evaporation occurs for 10 minutes.

Assume 100% coverage of spill using polyballs which reduces the spill surface area by 80%.

Chemical Categorization:

Substance: aqueous ammonia

Category: toxic liquid

Release Condition: instantaneous liquid spill resulting in toxic vapor cloud

Toxic Endpoint: 0.14 mg/L (200 ppm)

Site Categorization:

Roughness Length: 50 cm

Worst-Case Meteorological Conditions:

Wind Speed: 1.5 m/s (3.4 mph)

Stability Class: F (corresponds to stability class 6 in model output)

Relative Humidity: Not applicable to AFTOX

Ambient Temperature: 36.0° C (96.8° F)

Worst-Case Scenario Release Calculations

Volume of max. single vessel of aqueous ammonia:	**12000.0**	gal.
	1604.2	ft^3
Assumed depth of dike:	2.75	ft.
Asumed length of dike:	16.0	ft.
Assume width of dike:	39.0	ft.
Volume of dike:	1716.0	ft^3
Total surface area of dike:	624.0	ft^2
Assumed spill surface polyball coverage:	80.0	%
Effective surface area of spill (A):	**124.8**	ft^2
	11.59	m^2

Worst-Case Ammonia Emission Rate Calculations[1]

Input Parameters	
Wind Speed, Ur:	**1.5** m/s
Release Temperature, Trel:	**96.8** deg F
	36.0 deg C
	309.15 deg K
Molecular Weight of Ammonia, Mw:	17.03 kg/kmol
Area of Spill, A:	**124.8** ft^2
	11.59 m^2
Intermediate Calculations	
Vapor Pressure of Hydrazine, Pvh:	3615.9 Pa
Partial press. H_2O vapor over aqua ammonia, $Pv(H_2O)$:	0.57 psi
	3,912 Pa
Partial press. NH_3 vapor over aqua ammonia, $Pv(NH_3)$:	8.44 psi
	58,203 Pa
Total vapor pressure of aqua ammonia solution, Pv:	9.01 psi
	62,115 Pa
Avg. molecular weight of water vapor and aqua NH_3 solution, M_T:	17.09 kg/kmol
Emission Rate Calculations	
Emission rate including ammonia and water vapor, Epool:	0.0210 kg/s
	2.77 lb/min
Emission rate of ammonia only, ENH_3:	0.0196 kg/s
	2.59 lb/min

[1] For 19.1% aqua ammonia solution based on *EPA's Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Releases* (May 1993)

APPENDIX D

ALTERNATIVE CASE DISPERSION MODELING RESULTS AND CALCULATIONS

USAF TOXIC CHEMICAL DISPERSION MODEL

AFTOX

Otay (CA)

DATE: 11-21-2000
TIME: 1600 LST

INSTANTANEOUS RELEASE

AMMONIA(29%)
SHORT TERM EXPOSURE LIMIT (STEL) IS 35 PPM (24 MG M-3)
TIME WEIGHTED AVERAGE (TWA) IS 25 PPM (17 MG M-3)

TEMPERATURE = 16.7 C
WIND DIRECTION = 0
WIND SPEED = 2.86 M/S
SUN ELEVATION ANGLE IS 7 DEGREES
CLOUD COVER IS 0 EIGHTHS
GROUND IS DRY
THERE IS NO INVERSION
ATMOSPHERIC STABILITY PARAMETER IS 3.5
SPILL SITE ROUGHNESS LENGTH IS 50 CM

THIS IS A LIQUID RELEASE
TOTAL AMOUNT SPILLED IS 53 GAL
AREA OF SPILL IS 20 SQ M
EVAPORATION RATE IS 4.26 LBS/MIN
THE CHEMICAL WILL EVAPORATE IN 93 MIN
CONCENTRATION AVERAGING TIME IS 10 MIN
ELAPSED TIME SINCE START OF SPILL IS 93 MIN
HEIGHT OF INTEREST IS 0 M

AT 93 MIN, THE MAXIMUM DISTANCE FOR 200 PPM IS 34 M
MAXIMUM TOXIC CORRIDOR LENGTH = 84 M AT 93 MIN
DIRECTION & WIDTH 180 +/- 45 DEG

PG&E Dispersed Generating, LLC

Offsite Consequence Analysis - Alternative Case Scenario for Ammonia

Alternative Case Scenario Release Conditions
Alternative Case Scenario:
Transfer hose between loading truck and ammonia tank decouples. Spill includes all contents of hose and 30 sec. release of ammonia at max. truck transfer pump rate of 100 gal/min before truck stops pumping. Mitigation in place so entire spill spreads into low-lying containment area at depth of 1 cm.
Chemical Categorization:
Substance: aqueous ammonia
Category: toxic liquid
Release Condition: instantaneous liquid spill resulting in toxic vapor cloud
Toxic Endpoint: 0.14 mg/L (200 ppm)
Site Categorization:
Roughness Length: 50 cm
Alternative Case Meteorological Conditions:
Wind Speed: 2.86 m/s (6.4 mph)
Stability Class: C / D (corresponds to stability class 3.5 in model output)
Relative Humidity: Not applicable to AFTOX
Ambient Temperature: 16.7° C (62.1° F)

Alternative Case Scenario Release Calculations		
Assumed diameter of transfer hose:	2.0	in.
	0.17	ft.
Cross-sectional area of the hose:	0.02	ft^2
Assumed length of hose:	15	ft.
Volume of hose:	0.33	ft^3
Max. pump flow rate between truck and tank:	100.0	gal/min
Time duration of spill:	0.5	min.
Volume spilled due to truck pump:	50.0	gal.
	6.68	ft^3
Total volume of ammonia spilled:	7.0	ft^3
	52.4	gal.
Assumed depth of pool:	1.0	cm.
	0.0328	ft.
Total surface area of spill:	**213.7**	ft^2
	19.85	m^2

Alternative Case Ammonia Emission Rate Calculations [1]

Input Parameters		
Wind Speed, Ur:	**2.86**	m/s
Release Temperature, Trel:	**62.1**	deg F
	16.7	deg C
	289.87	deg K
Molecular Weight of Ammonia, Mw:	17.03	kg/kmol
Area of Spill, A:	**213.7**	ft^2
	19.85	m^2
Intermediate Calculations		
Vapor Pressure of Hydrazine, Pvh:	1147.2	Pa
Partial press. H_2O vapor over aqua ammonia, Pv(H_2O):	0.24	psi
	1,648	Pa
Partial press. NH_3 vapor over aqua ammonia, Pv(NH_3):	3.61	psi
	24,913	Pa
Total vapor pressure of aqua ammonia solution, Pv:	3.85	psi
	26,561	Pa
Avg. molecular weight of water vapor and aqua NH_3 solution, M_F	17.09	kg/kmol
Emission Rate Calculations		
Emission rate including ammonia and water vapor, Epool:	0.0263	kg/s
	3.48	lb/min
Emission rate of ammonia only, ENH_3:	0.0246	kg/s
	3.25	lb/min

[1] For 19.1% aqua ammonia solution based on *EPA's Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Releases* (May 1993)

SECTION 5.0
ACCIDENT HISTORY AND INVESTIGATION

5.1 Background and Introduction

This facility is a new construction installation and has no accident history. Therefore, this section of the RMP centers on information about the responsibilities of individuals with respect to ammonia accident response, investigation, and follow-up. This section also includes procedures and practices for future "near misses". An emergency response flow chart is also provided that identifies the methodology for incident response and reporting.

5.2 Individual Responsible for Accident Investigations

The Regional Roving Manager will act as the Emergency Coordinator (EC) for this facility. The EC is responsible for all accident investigations and reporting at the facility. All emergency plans, accident investigation, external reporting and internal follow-up will be filed in the RMP Technical Document, which will be maintained at the facility.

5.3 Management Involvement

The EC is responsible for assuring that the appropriate investigations are conducted at the facility and that specific reports are generated. The EC is responsible for performing a post-accident investigation to determine the cause of the incident, the effectiveness of response procedures, the need for amendments to the response plan, and the need for additional personnel, training, and equipment. Once the investigation is completed, all revisions to the plan must be incorporated. The EC is responsible for distributing changes to appropriate sections of the plan to all persons responsible for specific response operations. Changes to the plan will also be distributed to all organizations that have received a copy of the plan (e.g., HMD, Police, Fire Department, Emergency Contractors, etc.). The EC oversees all emergency response compliance issues, which include approval of corrective measures and external reporting.

5.4 Handling A Near Miss

All near misses will be reported to the site EC. A "near miss" is any incident that would have resulted in an ammonia release, if specific actions would not have occurred. It is estimated that the most likely near misses could occur during maintenance and repair operations or during ammonia tank loading. SOP's will be in place to minimize the potential for near misses. With a management policy of continuous improvement, preventative actions and safety suggestions will be continually discussed and implemented to assure safe operation and procedure refinement. The EC will be responsible to make revisions to all safety and emergency action procedures.

5.5 Accidental Release Reporting and Investigation Flow-Chart

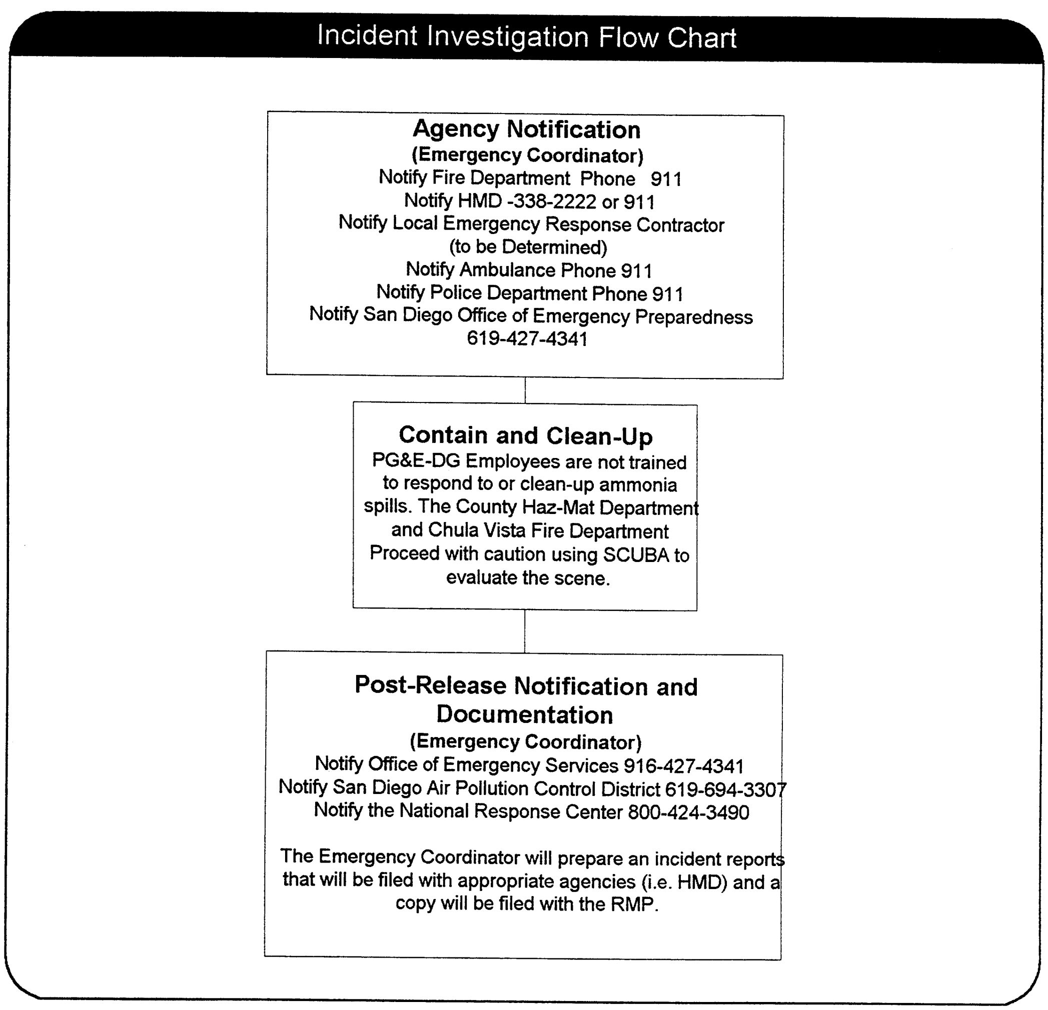
This public document presents the basis of the investigation flow-chart to be followed in the event of an accidental release of ammonia at the facility. The basic steps outlined in the flow-chart are as follows:

1) Report the incident to the appropriate regulatory agencies. After spill containment procedures are started, the EC or his designee will, within a reasonable time, shall report the incident to the appropriate regulatory agencies. The report will include the following information:

1. Name, address and phone number of the entity responsible for the spill
2. Name, title and phone number of the individual responding
3. Time and date of spill
4. Location of spill
5. Description of material released and the amount released
6. Cause of the release
7. Emergency action taken to minimize the threat to human health and the environment.

The complete report of the release is prepared and/or reviewed by the EC and forwarded to the appropriate agencies.

2) Follow-up procedures after the release include a post-accident investigation. Once the investigation has been completed, revisions to the appropriate plan will be incorporated and recorded on the Record of Amendments of this plan. Copies of the revisions will be made available to the staff and individuals responsible for specific response operations. The distribution list of the revisions will also include all organizations that have received a copy of the associated plan.



SECTION 6.0
PREVENTION PROGRAM 2

This facility-specific Prevention Program 2 identifies the basic elements that are the foundations of sound prevention practices as specified by the San Diego County CalARP program guidelines and California State guidelines. The objective of this Prevention Program 2 is to identify how PG&E-DG will operate safely and minimize the potential for accidental releases of ammonia. The sub-sections included in this program are as follows:

6.1 Safety Information
6.2 Hazard Review
6.3 Standard Operating Procedures
6.4 Employee and Contractor Training
6.5 Maintenance Practices and Procedures
6.6 Facility Compliance Audits
6.7 Incident Investigation

PG&E-DG will integrate these seven elements into the site risk management program, which will be implemented upon facility start-up. Understanding and managing the risks associated with ammonia is “common practice” for PG&E-DG facilities throughout the country. Working safely with ammonia always provides benefits beyond accident prevention. Preventive maintenance and routine inspections will lessen the number of equipment failures and down time. A well-trained workforce and integrated system design allows for efficient use of ammonia and lead to a properly operated Selective Catalytic Reduction (SCR) System.

6.1 Safety Information

PG&E-DG will maintain the up-to-date safety information related to the regulated substances, processes, and equipment used at the Chula Vista power generation facility. The following information will be maintained and kept up-to-date in the RMP Technical Document:

- Material Safety Data Sheets
- Maximum intended inventory of equipment in which the regulated substances are stored or processed (estimated to be 85% of 12,000 gallon tank = 10,200 gallons)
- Safe upper and lower temperatures, pressures, flows, and other process variables
- Equipment specifications and manufactures
- Codes and standards used to design, build, and operate the process

PG&E-DG has taken steps to ensure that the process is designed in compliance with recognized and generally accepted good engineering practices. PG&E-DG will seek to maintain compliance with federal or state regulations that address industry-specific safe system design. Industry-specific design codes and standards will be used as available to demonstrate a sound design. PG&E-DG shall update the safety information when major changes occur, which would otherwise makes the current information inaccurate.

Aqueous ammonia is the only regulated substance in use at the PG&E-DG power generation facility in Chula Vista. The safe use and management of other hazardous materials at the facility is regulated by compliance with various plans, including the Hazardous Materials Business Plan and the Spill Prevention Control and Countermeasures (SPCC) Plan. The ammonia-related process, which is part of the facility's emission control system, is described in the Executive Summary, Section 1.2 of this public document. Safety information requirements of the RMP comply with the federal, state and local regulations.

The design codes and standards to which the facility is constructed will be the most up-to-date as of the year 2000/2001, when the facility will begin operations. The basic design codes and standards employed at the facility are to conform to Zone 4 earthquake standards and are listed in Table below:

Table 6.1 Equipment Design Codes and Standards

Equipment	Design Codes/ Standards
Electrical	National Electrical Code C
Piping	American Society of Mechanical Engineers American National Standards Institute (ASME/ANSI B-31.1 1983)
Structures	Uniform Building Code (UBC), American Institute of Steel Construction (MSC) Conforms to seismic zone 4 design
Heat Exchanger	Tubular Exchangers Manufacturing Association (TEMA)
Pumps	American Society of Mechanical Engineers (ASME) and ANSI
Vessels	American Society of Mechanical Engineers (ASME) 1999
Compressors	American Society of Mechanical Engineers (ASME), ANSI, and National Electrical Manufacturers' Association I Enclosure
Concrete	American Concrete Institute (ACI) and Uniform Building Codes

Detection and Monitoring Devices and Methods:
Operation of the power generation facility is in general monitored by three types of devices: indicators (level/temperature/pressure), alarms (level/pressure/flow), and sensors (ammonia). All system variables are integrated into the process operation and are connected to the Plant Control System (PCS) located in the control room. This control room will be located at the site and a remote location at Hermiston, Oregon. A separate control enclosure will be provided for the SCR control system. This SCR control system will communicate with the PCS.

All devices that monitor process-related parameters can activate audible and/or visual alarms when conditions vary from the acceptable range. In many cases, pressure indicators will automatically shut the ammonia system down if a pressure drop is experienced (i.e. line breakage). The list of anticipated detection and monitoring devices in the ammonia handling system with their respective operating parameters is shown in Table 6.2.

Stack gas analyzers will be installed as part of the Continuous Emission Monitoring System (CEMS). The CEMS analyzes for two different chemicals: Nitrogen Oxides (NOx) and Oxygen (02), to ensure compliance with air pollution permit requirements. Any deviation from normal operating procedures that can result in NOx emissions above permitted levels is detected by the CEMS instruments and triggers an alarm in the control room. One condition that could cause an excess NOx is a problem with the ammonia handling, vaporization, and injection systems. An excess NOx emission sets in motion actions, which include investigating a possible leak or release and emergency shutdown.

Four area ammonia sensors will be placed around the ammonia tank on each corner of the containment. These sensors will sound an alarm when a leak or other ammonia release is detected at a pre-set concentration of 25ppm to 75ppm. A 75ppm detection will indicate a high high level alarm and an adjustable timer will be triggered to shut the ammonia system down For example, if a sensor detects in excess of 75ppm for 15 seconds, the system would shut itself down. Four more area ammonia sensors will be added around the vaporizer and the ammonia injection grid. Table 6.2 provides a list of detection and monitoring controls.

Table 6.2 - List or Detection and Monitoring Controls in the Ammonia Handling System

Description	Device Tag # From P&ID
NH3 Storage Tank Level	LIT-01
NH3 Storage Tank Level	LSLL-01
NH3 Storage Tank Pressure	PI-02
NH3 Pump Discharge pressure	PSLL-02
Area NH3 Detection (Tank North)	AI-01
Area NH3 Detection (Tank South)	AI-02
Area NH3 Detection (Tank East)	AI-03
Area NH3 Detection (Tank West)	AI-04
Area NH3 Detection (Vaporizer North)	AI-05
Area NH3 Detection (Vaporizer South)	AI-06
Area NH3 Detection (Injector Grid East)	AI-07
Area NH3 Detection (Injector Grid West)	AI-08
A & B Filter Differential Pressure	PDI-02
A & B Supply Pump Failure	XA-21
A & B Supply Pump Failure	XA-11
A & B Supply Pump Failure	XA-01

Note: Final sensor arrangement and specifics equipment will be detailed in the RMP Technical Document.

6.2 Hazard Review

Due to the relatively low hazardous nature of aqueous ammonia, a full Process Hazard Analysis (PHA) is not required. The HMD requires a minimum "What If" hazard evaluation as the Hazard Review methodology. PG&E-DG consulted with the County of San Diego Department of Environmental Health (DEH) to decide which hazard review methodology best suited to determine and evaluate the hazards of the process being analyzed. A checklists and question and answer method was used for this Hazard Review. This methodology proved to be adequate for the limited complexity of this system.

This site qualifies for a Program 2 process, which required PG&E-DG to conduct a Hazard Review. The Hazard Review helped to determine and set the stage for meeting applicable codes and standards and identification of potential failures. The Hazard Review also helped focus emergency response planning efforts. The Hazard Review formed the basis for understanding how the system is to operate and continuing to operate safely. During this review, specific hazards were identified and safeguard recommendations were made and implemented into the original design.

PG&E-GE conducted the hazard review in cooperation with the County HMD to review of the hazards associated with the regulated substances, processes, and procedures. The review identified the following:

- The hazards associated with the process and regulated substances
- Opportunities for equipment malfunctions or human errors that could cause an accidental release
- The safeguards used or needed to control the hazards or prevent equipment malfunction or human error

- Steps and equipment used or needed to detect or monitor releases

Since this facility is still in the planning stages, all processes are designed to meet current industry standards or federal or state design rules. The hazard review focused on the piping and instrumentation designs (i.e., process controls) to determine whether the process is designed to minimize the potential for releases and to initiate rapid shutdown if a release were to occur. The hazard review included the consideration of applicable external events, including seismic events, sabotage, and flooding. PG&E-DE has documented the results of the hazard review in this Public RMP and the Internal RMP Technical Document and will ensure that problems identified are resolved in a timely manner prior to system start-up.

A Hazard Review shall be conducted at least once every five years. PG&E-DG will also conduct reviews whenever a major change in the process occurs. All issues identified in the hazard review shall be resolved before startup of the process.

The specific Hazard Review supporting documentation (i.e. P&IDs) is provided in the Internal RMP Technical Document. Recommendations from the Hazard Review are summarized in the table below:

Table 6.3 Recommended Items From Hazard Review

Recommendation	Implementation Date
1. Prepare written SOP for unloading the ammonia	Prior to Start-Up
2. Prepare an SOP that includes recording visual monitoring	Prior to Start-Up
3. Prepare SOPs for preventative maintenance	Prior to Start-Up
4. Prepare procedure for startup that states position of all valve must be in the proper position	Prior to Start-Up
5. Prepare an SOP for response to high level alarms	Prior to Start-Up
6. Install truck barriers at the unloading area. Proposed barriers would protect valves and aqua ammonia connections at the bulkhead.	Prior to Start-Up
7. Add an audible and/or visual alarm and/or paging system will be connected to the ammonia alarms during loading operations.	Prior to Start-Up
8. Write into the unloading procedures to have the operator/truck driver check to see if there is a problem if the level indicator on the tank does not increase upon unloading. Procedures for unloading will be specific to this site and a PG&E representative will review procedures with drive before every unloading operation.	Prior to Start-Up
9. Add a high-high level alarm on the aqueous ammonia storage tank. This will help ensure that tank is not overloaded during loading operations.	Prior to Start-Up
10. Include in procedures for unloading that the PG&E regional manager must check the bill of lading for the ammonia delivery to ensure that there is sufficient capacity in the tank to accept the ammonia volume.	Prior to Start-Up
11. Add a local audible alarm for high pressure on the ammonia tank.	Prior to Start-Up
12. Follow up to see whether PG&E Generating will need to include an air compressor in the design available for purging the ammonia unloading hose.	Prior to Start-Up
13. Consider override on the interlock on low low level for	Prior to Start-Up

instrumentation errors.	
14. Make certain that the CEMS building and all other structures meet UBC Zone 4 requirements.	Prior to Start-Up
15. Consider alarm logic that shuts ammonia pumps off on high high alarm for 2 out of 4 sniffers. The concern is one sniffer could give a false reading and two would confirm a release.	Prior to Start-Up
16. Sensors will be programmed to trigger an alarm at 25ppm and include a time of excursion over the 75-ppm limit. The excursion time will be adjustable and will trigger the ammonia system to shut down.	Prior to Start-Up
17. Install ammonia sensors near the vaporizer skid, around the tank, and near the ammonia injection grid. The control panel will be designed to add more sensors as needed.	Prior to Start-Up
18. Consider the need for a thermal relief valve with a rupture disc on the ammonia transfer line.	Prior to Start-Up
19. Include double block & bleed in corrective maintenance procedures when shutting in lines for maintenance purposes.	Prior to Start-Up
20. Evaluate set point for shutdown on the pressure of the ammonia feed to the vaporizer for low low pressure to ensure that 30 psig is the proper setting.	Prior to Start-Up
21. Configure the NOx alarm to indicate a rate of change for NOx emissions from the CEMS to indicate a potential hazard. If a rapid rate of change is experienced, procedures may require that the ammonia system should be shut down.	Prior to Start-Up
22. Develop inspection, maintenance, and operating procedures prior to initial startup.	Prior to Start-Up
23. Develop facility wide security options prior to startup.	Prior to Start-Up
24. Install secondary containment for the unloading pad that is sloped to a sump and/or bermed area.	Prior to Start-Up
25. Ensure that if piping that exits the secondary containment areas through the wall, exits are properly sealed to maintain the containment integrity.	Prior to Start-Up

Note: Hazard Review documentation is provided in the RMP Technical Document. This documentation includes, "what if" questions and answers, the piping and instrumentation drawings (P&ID's), specific equipment and their sensitivities and recommendations implemented.

6.3 Standard Operating Procedures

PG&E-DG will prepare written operating procedures that provide clear instructions or steps for safely conducting activities associated with the aqueous ammonia process consistent with the safety requirements. Operating procedures and instructions provided by equipment manufacturers and developed by persons knowledgeable about the process and equipment are used as a basis for the operating procedures. Detailed operating procedures are kept on file and included in the facility RMP Technical Document. The following is a list of standard operating procedures (SOP's) for the Aqueous Ammonia System at the facility.

- Initial startup procedures
- Unloading Procedures - Ammonia Pre-Delivery and Post-Delivery Checklist
- Normal system operations parameters
- Temporary operations bypass and shutdown
- Emergency shutdown and operations

- Normal shutdown
- Startup following a normal or emergency shutdown or a major change that requires a hazard review
- Consequences of deviations and steps required to correct or avoid deviations
- Equipment inspections
- Maintenance Schedule

PG&E-DG shall ensure that the operating procedures are updated whenever a major change occurs and prior to startup of the changed process. The following SOPs will be developed in addition to the SOPs provided by the manufacturer of each piece of equipment:

- Trouble-shooting including temporary operations (emergency shutdowns including start-ups following a normal or emergency shutdown or a major change)
- Liquid Ammonia Pump Operations (Installation, Start-up, Trouble-shooting, Preventative Maintenance)
- SCR Ammonia Injection System Shutdown Procedure Automatic Ammonia Shutdown
- Manual Ammonia Shutdown

Specific procedures will be kept in the RMP Technical Document kept at the facility. Standard operating procedures (SOPs) will be reviewed and updated every two years or anytime changes to equipment and procedures are made in accordance with PG&E-DG management policies. Detailed P&ID's and SOPs for this site are also included in the RMP Technical Document.

Management of Change Procedures:
Contemplated changes to a process must be thoroughly evaluated to fully assess their impact upon safety. Reliable long-term operation of the facility requires that changes to the facilities and the documentation used to operate, maintain, and administer the facilities be closely managed. The purpose of the Management of Change program is to provide procedures for managing changes to plant equipment, systems, operating documents, and procedures. This provides a structure for plant configuration management, document change control, and the required personnel notification and training. Since this facility is unmanned most of the time, roving regional managers will act as the primary point for all procedures and change of processes. The regional managers must document and update procedures if changes are made.

In general, if any employee who believes that equipment, system, procedure, or other site document should be changed or modified, they should initiate a change/modification and submit it to the appropriate regional manager for approval. Information provided to support the request should be as detailed as possible. The change/modification request will be approved as needed within the following guidelines:

1. The Regional Manager will approve all changes/modifications that affect a site.
2. Changes to equipment and equipment maintenance procedures will be approved by the Regional Manager with input from Maintenance Contractors.
3. Changes that affect more than one site, plant modifications (other than minor equipment changes or substitutions), changes to safety and environmental procedures, and changes that may impact any contract will be approved by the Regional Manager.

The Regional Manager is the designated RMP Coordinator and is responsible for maintaining, and updating of the RMP and associated programs, as well as training on the RMP requirements and how to comply with its provisions.

6.4 Employee and Contractor Training Requirements

PG&E-DG ensures that any employee working on or near the covered process has been trained or tested competent to perform their duties and not risk an ammonia release. PG&E-DG will certify in writing, through training records, employees have the required knowledge, skills, and abilities to safely carry out the duties and responsibilities.

Refresher training will be conducted at least once every year or whenever there are changes to the equipment and procedures. Both original and refresher training will be documented as well as the verification that training was understood. Drills will be conducted at least every 6 months (if required) and will cover the following:

- evacuation procedures handling of spills and leaks
- incident reporting procedures
- location of emergency fire-fighting equipment first aid and rescue procedures
- use of protective equipment including respiratory equipment location and use of shut-off valves
- locations, purposes, and use of safety showers, eye wash fountains, and other sources of water for emergency use
- operating procedures
- prearranged procedures for obtaining emergency medical care

Each employee working directly with the ammonia process at the facility shall have been trained to operate the equipment safely and competently. They must also how they are to respond in case of emergency. PG&E-DG will verify that employees understand the training through verification of understanding of the training that may include observation of performance, written testing, and/or oral testing. Training materials will be updated when equipment or instrumentation is changed.

First Responders Awareness Level will be given to individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

- An understanding of what hazardous substances are, and the risks associated with them in an incident.
- An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.
- The ability to recognize the presence of hazardous substances in an emergency.
- The ability to identify the hazardous substances, if possible.
- An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.
- The ability to realize the need for additional resources and to make appropriate notifications to the as outlined in the emergency response plan.

Facility's and Contractors' Responsibilities for Work on Covered Processes:
When selecting a contractor, PG&E-DG will obtain and evaluate the contract employs safety performance and programs. In addition, PG&E-DG will ensure that the contractor has the appropriate job skills, knowledge, and certifications. Finally, the contractor work methods and experience will be periodically evaluated. Contract employers will be also educated about potential fire, explosion, or toxic release hazards related to the contractor's work in the process. The contract employer will be required to train their employees to a level adequate to safely perform their job. PG&E-DG will also inform contractors of any applicable safety rules of the facility, and will ensure that the contractors have informed their employees. The applicable provisions of the Emergency Action Plan will be explained to the contractor employer.

The contractor will assure that each contract employee will be trained in the work practices necessary to safely perform his/her job. The training program will include Initial training consisting of an overview of the process and operating procedures as necessary. Also, refresher training will be required at least every three years.

The contractor will assure that each contract employee is instructed in the potential fire, explosion, or toxic release hazards related to the work in the process area. The contract employer will also assure that the contract employee is aware of the applicable provisions of the Emergency Action Plan. The contract employer will ensure that each contract employee follows the safety rules of the facility including the safe work practices. The contractor will advise PG&E-DG of any unique hazards presented by the contract employer's work, or of any hazards found by the contract employee's work.

6.5 Maintenance

PG&E-DG will prepare and implement procedures to maintain the on-going mechanical integrity of the ammonia process equipment. Procedures and instructions provided by covered process equipment vendors are the basis for maintenance procedures. Each maintenance person shall be trained to ensure that the employee can perform the job tasks in a safe manner, each such employee shall be trained in the hazards of the process, how to avoid or correct unsafe conditions, and other associated procedures applicable to the job tasks. All maintenance contractors shall ensure that each contract maintenance employee is trained to perform the maintenance procedures developed under PG&E-DG safety guidelines.

PG&E-DG will perform inspections and tests on process equipment. Inspection and testing procedures shall follow recognized and generally accepted good engineering practices. The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations, industry standards or codes, good engineering practices, and prior operating experience. In order to ensure the continued proper operation of PG&E-DG's ammonia process and monitoring equipment, the plant operators and maintenance crews perform regular maintenance throughout the facility.

The types of maintenance procedures in place at the facility are the following:

- Routine Inspection Forms
- Controller Logs
- Corrective Maintenance Work Orders
- Preventative Maintenance Master Schedule
- Ammonia Safety Inspection Checklist
- Annual Ammonia Tank Inspection Form

Maintenance procedures follow a written maintenance manual. For unscheduled maintenance, plant operators document what work needs to be done, and enter the request with the maintenance supervisor. A corrective action work order is issued to maintenance personnel. Documentation is recorded in the operations log and/or shift inspection forms. Visual inspections of the system are conducted periodically. The ammonia supplier also conducts an annual tank inspection based on industry standards to identify needed repairs.

6.5 Compliance Audits

PG&E-DG shall certify that they will evaluate compliance with the provisions of the RMP Public and Technical Documents at least every three years to verity that the procedures and practices developed are adequate and are being followed. The compliance audit will be conducted by at least one person knowledgeable in the process, equipment, regulations, and training requirements. A report will be developed identifying audit findings. PG&E-DG will promptly determine and document an appropriate response to each of the findings of the compliance audit and document that deficiencies have been corrected. The compliance audit reports and follow-up recommendation completion list will be maintained in the facility RMP Technical Document.

6.6 Accident Investigation

PG&E-DG shall investigate each incident that resulted in, or could reasonably have resulted in, a catastrophic ammonia release. An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.

A summary shall be prepared at the conclusion of the investigation that includes at a minimum:

- Date of incident and investigation
- A description of the incident
- The factors that contributed to the incident
- Any recommendations resulting from the investigation

PG&E-DG will promptly address and resolve the investigation findings and recommendations. Resolutions and corrective actions shall be documented. The findings shall be reviewed with all affected personnel whose job tasks are affected by the findings. Investigation summaries shall be retained for five years in the RMP Technical Document.

SECTION 7.0
PREVENTION PROGRAM 3

(Not Applicable)

SECTION 8.0
EXTERNAL EVENTS

8.1 Background and External Events Considered

An important aspect of any Risk Management Plan is the evaluation, review and mitigation of potential releases that could be caused by external events. External events are considered to be natural or human caused actions that could lead to releases of hazardous substances (i.e., ammonia). For the purposes of this external event analysis, the following external types are considered:

- **Seismic Actions (Earthquake)**
- **Unauthorized Persons Activities (Sabotage)**
- **Major Floods**
- **Internal and External Sources of Fire**
- **Operator Error**

8.2 Seismic Actions (Earthquake)

The objective of the seismic assessment is to assess relative seismic vulnerabilities of the equipment when subject to a major earthquake. The seismic assessment takes into account a site-specific geologic evaluation developed during project design and an engineering assessment of standards to be applied to the facility design and installation. The site-specific geologic evaluation includes consideration of active earthquake faults in the region and their impact on the ground motion at the subject property. The engineering assessment for this process consists of assuring that the aqueous ammonia system engineering and the foundation designs are consistent with seismic building codes (zone 4) and currently accepted practices and requirements.

Seismic lateral forces are the primary external actions considered for evaluation any potential danger to the equipment that will contain aqueous ammonia. The seismic hazards at this site can be characterized as being of about average severity, as compared to the southern region as whole. This region is seismically active, and structures in this area may experience several earthquakes of moderate to major strength during the life span of the structure.

The primary seismic hazards associated with an earthquake are ground shaking, and surface fault rupture. Secondary hazards associated with seismic waves include, hillside landslide, earth flow, mud flow, ground differential settlement, soil lurch cracks, ground subsidence, and fire. It is estimated that the seismic-induced geologic hazards such as surface rupture, landslides, liquidifaction and settlement, will have either a low probability of occurrence or minimum impact to the aqueous ammonia system. Current building codes and engineering specifications will provide for sufficient structural integrity to account for the potential hazards.

A seismic engineering assessment will be performed primarily on equipment that contains aqueous ammonia. Since the facility is not constructed at this time, a seismic engineering walkdown can not be performed. However, current earthquake design standards will be integrated into the system design and installation. After the system is installed, a site walkdown will be performed to ensure the construction meets the design specifications.

8.3 Unauthorized Persons Activities (Sabotage)

Unauthorized persons are prevented access to the ammonia system by a large fence that is 10 feet high with opaque slats. The gate to the facility is always locked. Only PG&E-DG employees or authorized contractors will have access to the facility. The keys to the Plant Control System (PCS) room are specific to those locks and access to the keys is limited for security purposes. During most hours, the facility is unmanned and fences are the sole means to prevent unauthorized access. It is anticipated that security company employees may patrol the area when vandalism and other problem are experienced or anticipated. In addition, due to the automated control system, if unauthorized persons were to gain access and attempt to cause a release, the active and passive mitigation measures would reduce the potential for a significant release.

8.4 Major Floods

The Federal Emergency Management Administration (FEMA) floodplain maps show the site as being within the 100-year floodplain. However, the FEMA maps were prepared prior to the leveling of the site that occurred several years ago. The FEMA maps indicate the 100-year floodplain level at the site is 44 feet Above Mean Sea Level (AMSL). However, the site has been filled and leveled to a minimum elevation of 55 feet AMSL. Therefore, this site is 10-feet above the 100-year floodplain level. Based on this information, it is estimated that the threat of flood will have a low probability of occurrence and a minimum impact on the ammonia system.

8.5 Internal and External Sources of Fire

This site is a new construction project and will be designed to conform to the latest Uniform Fire Codes. One of the major flammable sources is the underground natural gas line, which supplies gas to the turbine. No natural gas will be stored on site in tanks. Automatic shutoff valves will close the gas line supply to the turbines in the event of a plant malfunction, fire, or ground shaking activity. An automatically operated fire suppression system will be installed at the facility to extinguish gas and/or electrical fires. Fire and ammonia release emergency response training will be conducted with the Local Fire Department. External fires are not a significant threat to the ammonia process. Flammable brush, grass, and trees are not present on-site or on the adjacent properties. Large gravel areas are planed for the area around all power plant structures.

8.6 Operator Error

Operator error is a potential external source of accidents that could lead to ammonia releases. There are several types of accidental errors that could lead to problems with the ammonia system. The primary risk occurs when the ammonia tank is being filled. The tanker truck operator is an employee of the ammonia supplier and is governed by Department of Transportation (DOT) Rules and Regulations. PG&E-DG will develop a set of SOP's for this transfer operation. A Company employee will be on-site when transfer operations occur. The tank truck operator and the Company employee will have site specific training on the loading procedure and other associated ammonia safety and emergency response procedures. Other areas that may provide an opportunity for error include maintenance functions such as valve replacement and system repairs. To minimize the potential for human error resulting from maintenance employees and contractor actions, PG&E-DG will require proper training and adherence to SOP's for system maintenance and repair. Conceivable types of potential human error scenarios will be mitigated with facility improvements (i.e. curbing, guards, controls, valves, sumps, etc.) and with specific SOP's. All facility improvements and SOP's will be detailed in the RMP Technical Document, which will be kept on-site.

8.7 UBC Edition of Process Design

The ammonia emission system will be designed and constructed in the year 2000 or 2001. The seismic design of all equipment will be performed in conformance with all current building codes that are in effect. The facility is located in the US Geological Survey (USGS) and the Uniform

Building Code (UBC) Seismic Zone 4. Zone 4 represents the areas with the highest seismic risk. A variety of American Society of Mechanical Engineers (ASME), National Electric Code (NEC), National Electrical Manufacturers' Association (NEMA), American Institute of Steel Construction (AISC), American Concrete Institute (ACI) standards and the American National Standards Institute (ANSI) standards will also be used during design and installation.

8.8 Mitigation for Potential Offsite Release

The external events considered in this section all pose some threat of an ammonia release. However, the facility will have several features built-in that will reduce or eliminate a release of ammonia if an event were to occur. A summary of potential hazards, process controls, and mitigation is provided in the following Table 8.1.

Table 8.1 External Event Hazard Mitigation Summary

External Event	Potential Hazards	Process Control and Mitigation
1) Seismic Actions (Earthquake)	An ammonia process line break is the major hazard associated with earthquake actions.	A seismic walkdown will be performed before operations begin. This will ensure that the system is installed as per current design standards. Controls will be in place to shutdown the process if a major earthquake were to occur.
2) Unauthorized Persons Activities (Sabotage)	Attempted valve operation Walking or climbing on process lines	A 10-foot security fence spanning the perimeter of the facility and proper key control is the main barrier to unauthorized activity. Also, vital on-site controls will be kept behind locked doors. Other security measures will include periodic surveillance and inspection.
3) Major Floods	Erosion could lead to foundation movement and pipe breaks. This hazard is highly improbable due to being 10 feet higher than the 100-year floodplain.	All foundations and structures will be built using appropriate standards and codes. These codes assure that the equipment and associated structures are built to withstand adverse weather.
4) Internal and External Sources of Fire	Fire could result in building collapse and lead to line breakage.	A fire experienced by on-site buildings will be detected and the turbine will be tripped, which will shut down the SCR system immediately. The fire alarm will sound, CO2 flood will engage, and responders will be notified.
5) Operator Error	Wrong valve open and releases could occur. Improper maintenance. Poor inspections, etc.	The main methods for mitigating operator error will be detailed SOP's and associated training, secondary containment, and integrated process controls.

Note: The site safety training, management SOP's and emergency response procedures will be assurance that releases of ammonia would be minimized or eliminated if an external event were to occur.

SECTION 9.0
EMERGENCY RESPONSE PLAN

9.1 Background and Introduction

This section of the RMP Public document provides an overview of the emergency response procedures for all incidents involving the aqueous ammonia tank and system. This section includes an outline and summary of how PG&E-DG will respond to an ammonia-related spill or accident. Specific internal emergency response procedures will be prepared and contained in the RMP Technical Document. Specific internal procedures will be prepared and refined through the a series of tabletop exercises and cooperation with the Local Fire Department, County Hazmat and PG&E-DG's Emergency Response Contractor. In addition to specific emergency response procedures, a copy of the current HMD Business Plan will be included in the RMP Technical Document.

PG&E-DG will implement an emergency response program for the purpose of protecting public health and the environment. The emergency response program includes the following elements:

1. An emergency response plan that contains the following elements:
   - Procedures for informing and interfacing with the public and local emergency response agencies about accidental releases, emergency planing, and emergency response.
   - Documentation of proper first-aid and emergency medical treatment necessary to treat accidental human exposures.
   - Procedures and measures for emergency response after an accidental release of a regulated substance.

2. The program will also contain procedures for the use of emergency response equipment on-site and for equipment inspection, testing, and maintenance. This will include procedures that will be followed by PG&E-DG's Emergency Response Contractor.

3. The plan also contains training in relevant procedures and relevant aspects of the Incident Command System (ICS) and how the ICS integrates at the facility. This will include tabletop exercises to be conducted with the local fire department, the County HAZMAT Team, an Emergency Response Contractor, and responsible PG&E-DG operators and managers.

4. The plan also includes procedures for reviewing and updating the emergency response plan to reflect the current facility arrangement, to incorporate changes in management at the site, and to ensure that employees are informed of changes.

PG&E-DG will work with the local emergency response official's to provide all information necessary for integrating this facility into the community emergency response plan

9.2 Emergency Response Procedures

This section of the RMP Public Document provides a summary of the emergency response procedures to respond to specific emergencies that pertain to the aqueous ammonia process tank and system. More detailed emergency response SOP's will be contained in the RMP Technical Document. This section of the plan includes the information describing the actions of employees over the course of a release event. Much of the information is outlined in the emergency response flow-chart provided on page 9-4.

9.3 Offsite Response Assistance Requirements and Abilities:

The emergency response plan includes a contact list of outside response organizations that would be called upon to provide assistance in the event of a fire or aqueous ammonia release incident, such as fire-fighting, Hazmat response, security and public notification. The items are discussed in more detail below:

9.3.1 Fire-Fighting

The facility will have an automatic fire detection and suppression system. This system will be designed to control gas and/or electrical fires. The Local Emergency Responders (Fire Department) will work with PG&E-DE Emergency Coordinators on drills to determine specific hazards that are on site. The drills and training program will educate the Local Responders about the specific facilities and what response is expected.

9.3.2 County Hazardous Material Response Team

The County Hazardous Materials (Hazmat) Response Team will respond to all ammonia incidents at this facility. The County, along with the local fire department will be notified immediately of all alarms or ammonia incidents that result in a shutdown of the ammonia system. The Hazmat Response Team will respond with the primary purpose of protecting the public health and mitigating ammonia releases. PG&E-DG's response contractor will perform all spill clean-up and disposal of hazardous waste.

9.3.3 Ammonia Spill Response Contractor

PG&E-DG will contract with a local company to be the primary responder for this facility for all ammonia-related spills and alarms. This contractor will participate in all emergency response tabletop exercises and drills. The contractor will be identified at a later date in the facility RMP Technical Document.

9.3.4 Security

The security at this facility consists of a large fence and a gate. The gate is to remain locked at all times unless a PG&E-DG Operator is on-site. The Local Fire Department will either have keys to the facility or will be versed on the best method by which to gain access to the facility for response purposes.

9.3.5 Public Notification

PG&E-DG has primarily responsibility for regulatory notification. However, if a major event were to occur, the Incident Commander (Local Fire Chief) will have authority to initiate public notification and warnings.

9.4 Response Chain-of-Command and Delegation of Authority

The PG&E-DG San Diego Area Manager will always act as the designated Emergency Coordinator (EC) at the facility. The EC's specific duties and responsibilities will be detailed in the emergency response plan. Responses to aqueous ammonia spills and releases will be initiated by immediately notifying the EC. In the absence of the primary EC, authority is delegated to the Assistant EC to serve as the EC. In the absence of the primary EC, PG&E-DG's Emergency Response Contractor may also assume responsibility for all response procedures, including notifying the primary EC.

Response may be initiated by an ammonia sensor alarm or by an on-site individual if repairs or tank filling is being performed. For sensor alarms, PG&E-DG's internal procedures identify a fully manned remote site control center (Remote Operator). When one ammonia sensor is triggered, initial steps will be made to determine if it is a false sensor alarm. Ammonia system operational parameters will be checked to determine if there is a pressure differential or if there is some other indication of a system leak. If it is deemed to be a false sensor alarm, the PG&E-DG EC will be dispatched to the site to determine the cause of the false alarm and take steps to repair the sensor. It is estimated that under a single alarm, it will take the EC less than four hours to reach the site. The EC will take maintenance steps to get the ammonia sensor back on-line.

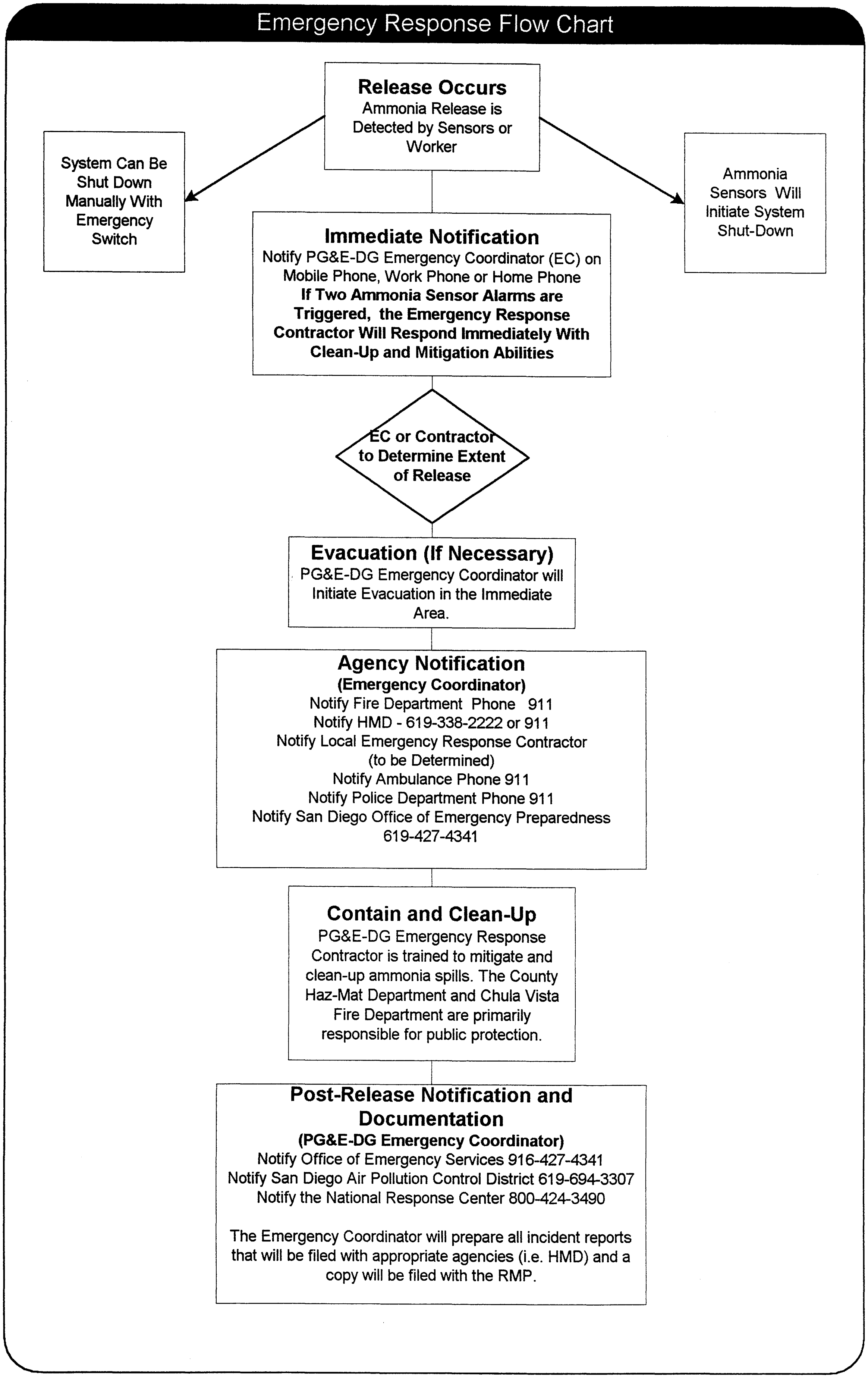
If a second sensor is triggered, the ammonia system will be shut down immediately by the Remote Operator. The PG&E-DG Emergency Coordinator will be dispatched to the site immediately. It is estimated that response time will be less than two hours depending on traffic and the EC's location at the time of the incident. If the alarms persist at a level above 75ppm after the system has been shut down or a third sensor is triggered, PG&E-DG Emergency Response Contractor will be dispatched immediately. Also, the Local Fire Department will be notified immediately. The Chula Vista Fire Department is located in the immediate vicinity and serves as the primary public response agency. The Fire Department becomes the on-site Incident Commander (IC) in the event of a fire or ammonia release. The Fire Department is responsible for securing the site and may delegate perimeter security and specific response actions to other base agencies, such as the local police and the County Hazardous Materials Response Team.

Post-release notification to Federal, State and local regulatory agencies, following the incident is the responsibility of the PG&E-DG Emergency Coordinator. Specific reporting to agencies will be identified in the facility emergency response plan.

9.5 Planned Drills with Emergency Responders

The Local Fire Department in coordination with a PG&E-DG's Emergency Response Contractor, Emergency Coordinator (EC) and the County Hazardous Material Response Team will perform planned emergency drills and/or tabletop exercises. The emergency responders have the capability and the equipment to safely enter the facility in the event of an ammonia release. They will assess the situation and take appropriate action to control, isolate or manage the release. The planned drills will help familiarize the responders with the layout of the facility.

The PG&E-DG EC as part of their annual ammonia safety and fire safety training, will conduct tabletop exercises. The ammonia release response training covers proper recognition, notification and evacuation procedures. PG&E-DG personnel will activate remote shut-off or isolation devices if a release were to occur. The training will also cover system shutdown logic, passive containment, active mitigation, accident scenarios and notification procedures. Ammonia training for all employees involved will be conducted before delivery of ammonia to the site and annually once the plant is in operation. Specific emergency response training topics and procedures will be supplied in the facilities RMP Technical Document.


Emergency Response Flow Chart
Release Occurs
Ammonia Release is Detected by Sensors or Worker
System Can Be Shut Down Manually With Emergency Switch
Ammonia Sensors Will Initiate System Shut-Down
Immediate Notification
Notify PG&E-DG Emergency Coordinator (EC) on Mobile Phone, Work Phone or Home Phone
If Two Ammonia Sensor Alarms are Triggered, the Emergency Response Contractor Will Respond Immediately With Clean-Up and Mitigation Abilities
EC or Contractor to Determine Extent of Release
Evacuation (If Necessary)
PG&E-DG Emergency Coordinator will Initiate Evacuation in the Immediate Area.
Agency Notification
(Emergency Coordinator)
Notify Fire Department Phone 911
Notify HMD - 619-338-2222 or 911
Notify Local Emergency Response Contractor (to be Determined)
Notify Ambulance Phone 911
Notify Police Department Phone 911
Notify San Diego Office of Emergency Preparedness 619-427-4341
Contain and Clean-Up
PG&E-DG Emergency Response Contractor is trained to mitigate and clean-up ammonia spills. The County Haz-Mat Department and Chula Vista Fire Department are primarily responsible for public protection.
Post-Release Notification and Documentation
(PG&E-DG Emergency Coordinator)
Notify Office of Emergency Services 916-427-4341
Notify San Diego Air Pollution Control District 619-694-3307
Notify the National Response Center 800-424-3490
The Emergency Coordinator will prepare all incident reports that will be filed with appropriate agencies (i.e. HMD) and a copy will be filed with the RMP.

SECTION 10.0
CalARP RMP CERTIFICATION

PG&E Dispersed Generating LLC,
Risk Management Program

This certification attests that to the best my knowledge, information, and belief formed a ter reasonable inquiry, the information submitted here is true, accurate, and complete. This certification is pursuant to Chapter 6.95, Section 25531 of the California Health and Sa ety Code.

Name (print): GARY VEERKAMP

Title: MANAGER - DESIGN AND INSTALLATION

Signature: Gary Veerkamp Date: 1/22/01